THE COLLEGE OF AGRICULTURE[1]

The College of Agriculture at Los Baños is the only institution in the Philippines presenting a full curriculum of university grade in agriculture and the agricultural sciences. It is fully co-ordinate in character and quality of work done, with the standard agricultural colleges of America. Its graduates are admitted to the best universities of America, with full standing as candidates for advanced degrees, for instance, in Wisconsin, Chicago, Illinois, Cornell, Columbia, Harvard, and Johns Hopkins.

The main object of the College is the teaching of science as practically applied to Philippine agriculture. This necessitates first, thorough grounding in the basic natural sciences, and second, thorough practical training in modern methods.

Since the applications of the modern agricultural sciences to Philippine problems and conditions had never been developed in these Islands, and since there had been no such thing in the Islands as comprehensive and well organized agricultural experiment station work, it was absolutely necessary to organize and carry a large amount of investigational work at the College in order *to develop the courses to be given here.* This has been in progress since the beginning and has reached such a stage that it not only forms the backbone of all advanced courses in the College, but innumerable phases of it, if presented in proper form, could now be used in farm schools or other schools, and for extension work among the farmers of the Islands. This last is considered one of the most important functions of an agricultural college in America.

The more ample development of experiment station work at the College, on a scale deemed *essential* to every American agricultural college, and to every progressive agricultural state on earth, will greatly increase its value, not only in the strengthening of its own courses, but will furnish results of the highest possible value throughout the Islands, in extension education of the people at large and in the practical development of Philippine agriculture.

The only students eligible to admission to the regular four-year course of this college are those who have graduated either from a fully organized high school or from the preparatory school of this college which is somewhat more advanced than the high schools in the work which it gives. Students received from the high schools are found usually to be weak in science, especially chemistry, physics, and biology, and may then be conditioned. Students with exceptional grades from intermediate schools are admitted

[1]General contribution from the College of Agriculture, No. 172.

to the two-year preparatory school. This two-year course is purely a technical high-school course and is not to be compared with the usual liberal-arts high school course. Its courses in mathematics, English, and the fundamental sciences are much stronger, much more intensive, and with far more completely developed laboratory and field training—all of the work being developed with special reference to agriculture, and in the hands of specially trained teachers. It therefore results that students who cannot go beyond the preparatory, still have a better elementary foundation for future work *in agriculture*, than if they were high school graduates. Graduates from the preparatory school are also better prepared to enter this College than are graduates from the regular high schools. However, when such students have graduated from the College, they are not given a regular university degree (B.S.) until they have finished the lacking 60 units of the history, literature, etc. of the regular high schools. A single attempt to confine entry to this college to graduates from high schools, made several years ago, was a disastrous experiment. Even if a student body could be recruited by force from the high schools, the results in training *for agriculture*, which is the prime purpose of this College, would not and could not give as good results as come through the operation of the present preparatory school. It is therefore greatly hoped that the time may soon come when a sufficient number of *agricultural high schools* having science courses as good as now exist in the College of Agriculture preparatory school, may be brought to effective operation in many parts of the Islands, and that these will eventually insure a properly prepared student supply to the College. As things are, students are now received from all the provinces of the Islands.

In addition to a regular course in general tropical agriculture, the College maintains special courses in sugar technology and in animal husbandry which give men thorough training for these special lines of work. Prerequisite to these are the first two years in the regular course or more. More students have been pressing forward for these special courses than could be properly accommodated.

One of the more serious special undertakings of the College has been the gradual building up of a highly trained Filipino faculty for itself. For this purpose, as well as for the training of the future technical men needed in this country in the agricultural sciences, men showing special ability and special aptitudes in the various directions are selected from among hundreds while still in undergraduate work. Such men are then given constant grooming until ready to go abroad for higher training. This system has produced uniformly satisfactory results, all such men having, as a rule, succeeded abroad, and in their work here, thereafter.

The College maintains through each vacation period (April–May) a summer school which always runs to full capacity. In addition to regular students, many outsiders attend these sessions. A number of teachers

from the schools of the Islands, especially farm-school teachers, attended the summer session of 1926. During these summer sessions, as a purely extension activity, free instruction in poultry raising is given to any persons desiring it, and numbers take this instruction.

The College permits the enrollment of women and each year the number is increasing. While they can easily carry the first two years, the last two of the College course are not suitable for women on account of the large amount of field work. As the number of women increases a special course for women should be instituted. The presence of women students has created no special problems as yet, the limited number now attending being carried with entire success. In America it is considered one of the very important functions of a college of agriculture to give an agricultural course for the many women who must stay with country life. In many such colleges the number of women equals or exceeds the number of men and this has been a potent influence in improving the conditions of rural life throughout the country. The need is far greater in this country.

The proposed addition of a two-year special course in Agricultural Education co-ordinate with the special courses in sugar technology and animal husbandry, would enable the College to turn out first class material for teachers in farm schools and agricultural high schools. Numbers of former graduates of this College are now serving in these capacities, but without normal training in these lines; their practical training in teaching has to be acquired, and this is only practicable and successful in case principals and associates with whom they are thrown prove sympathetic and helpful until the necessary experience has been gained—after which they are able to do good work. However, the need of a well organized and well staffed course in agricultural education is beyond question.

The College has received since its foundation several thousand students. It is indubitably the fact that these men, whether they graduate or not, can make greater successes of themselves, and be of greater service to the country, than if they had never partaken of the great advantages and opportunities offered here. Throughout the Islands, and in many lines of work, largely agricultural, they themselves are now proving this.

The College operates each year at its fullest possible capacity, and yet must turn many students away. Its extreme capacity is now about 600. This should be increased to 1,000 as soon as may be, if it is desired to gain for the whole country the strongly ameliorating influences that are bound to come from such an institution if properly operated.

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THE WORK OF BREEDING DISEASE RESISTANT CROP PLANTS AT THE COLLEGE OF AGRICULTURE AT LOS BAÑOS[1]

N. B. MENDIOLA AND G. O. OCFEMIA
Of the College of Agriculture

WITH SEVEN TEXT FIGURES

Any proper work in the breeding of disease resistant plants should be based on a thorough knowledge of plant diseases involved and the comparative value and susceptibility or resistance to these diseases of the parent varieties or strains which are used in the actual selection and hybridization work. Much has already been done by three departments of this College in laying this very necessary foundation,—by the Departments of Plant Pathology, Plant Physiology, and Agronomy. Considerable work has been done on coconut bud rot; citrus canker; bark rot of citrus; *Sclerotium* disease of rice, tomato, and pepper; carriers of the storage rot fungus; anthracnose of abacá, banana, mango, avocado, and pepper; *Rhizoctonia* disease of rice; damping-off disease due to *Pythium debaryanum;* diseases of tobacco; *Phytophthora* blight of citrus; *Phytophthora* disease of eggplant; bacterial wilt of *Chrysanthemum;* Fiji, mosaic, and smut and other diseases of sugar cane; mildew of maize; etc., etc. We know more or less the comparative resistance of the different species and varieties of fruit plants to the attack of such parasites as the *Loranthus.* We know, for example, that the carabao mango is more resistant to the *Loranthus* than the Juani and Pahutan

A College seedling variety of sugar cane resistant to Fiji and Mosaic diseases.

[1]Experiment Station contribution No. 372. Received for publication June 1, 1926.

varieties. All this work must be held constantly in view in any estimate of what has been accomplished in the way of breeding disease resistant plants.

Following are brief accounts of other phases of work which has been done or is under way in breeding disease resistant plants in the College of Agriculture.

SUGAR CANE (SACCHARUM OFFICINARUM L.)

The most serious cane diseases at present recognized in the Philippines are the Fiji disease, the mosaic, and the smut. The same diseases are found in other sugar cane countries of the world. In some of those countries the cane growing industry was threatened with ruin as a result of the

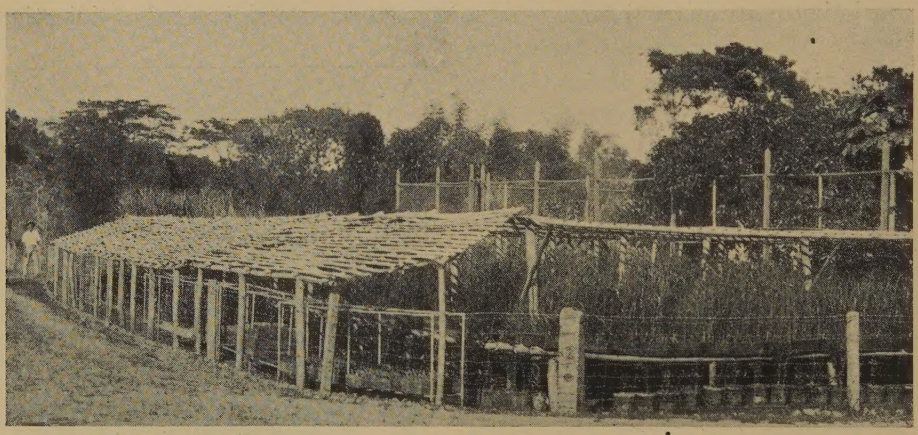

Fig. 2.—(P. B. 119 × C. A. C. 87) F_1 sugar cane seedlings in the nursery. (All photographs used in this article were by the Photographic Division, Department of Agronomy, College of Agriculture.)

damages caused by these diseases. And what saved the sugar men was the breeding of disease resistant varieties of sugar cane. Similar work has been done in the College of Agriculture at Los Baños since 1919. Briefly, the work consists in the selection of apparently resistant varieties, the obtaining of seedlings from them, and the selection, propagation, and tests of those seedlings found to be promising. In this work the Department of Plant Pathology of the College is co-operating with the Division of Plant Breeding. Already from the many thousands of seedlings which have been produced since 1919, a variety; namely, the C. A. C. 87 (fig. 1), has been propagated and is now grown and being tested on different farms in the Philippines. Data on these two varieties were published in THE PHILIPPINE AGRICULTURIST, Vol. X, p. 211–218, 1921, and Vol. XIII, p. 115–128, 1924. The variety C. A. C. 87 has been selected because

for many years now it has not shown susceptibility to Fiji and to mosaic diseases even when grown side by side with varieties heavily infected with these maladies. All standard varieties of sugar cane now in the Philippines are attacked by these two diseases. Because C. A. C. 87 is too hard a cane to use for small mills and has some objectionable features not found in standard varieties, it is still being improved in this College. During the last flowering season of sugar cane it was crossed with our variety P. B. 119, a soft and good variety, and we obtained from this cross about 50,000 seedlings (fig. 2 and 3). A good portion of this material has been sent to Del Carmen Central and to the Pampanga Sugar Development Company for test and selection in their experimental fields (fig. 4).

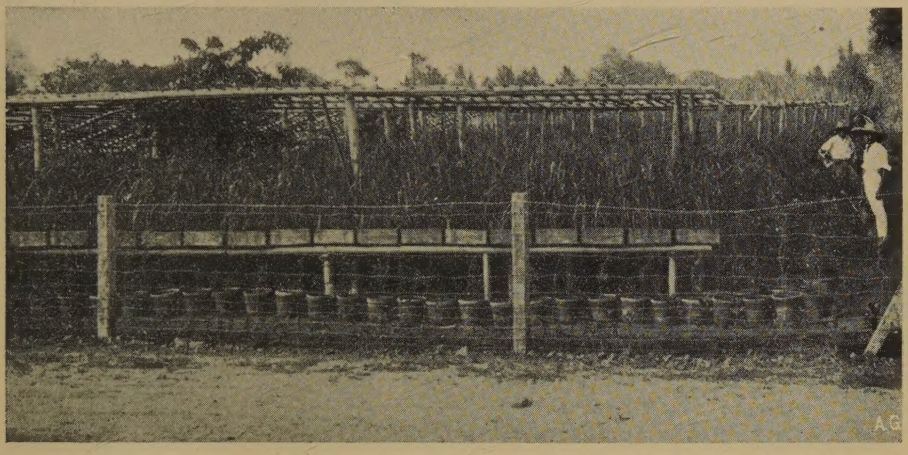

Fig. 3.—A closer view of sugar cane seedlings shown in figure 2.

The work of the College in the breeding of a Luzon White strain resistant to mosaic was begun in 1923. In that year four plants belonging to the Luzon White variety were found free from mosaic although standing among mosaic infected plants in a field in Lipa, Batangas. Since 1923 these four plants have been propagated every year and as a result we now have four lines which are being tested for resistance to the mosaic disease. The results of this study have been embodied in a paper which was read before the Los Baños Biological Club on January 18, 1926, and was published in the July, 1926, issue of The Philippine Agriculturist.

ABACÁ (MUSA TEXTILIS NÉE)

One of the most serious diseases of abacá, if not the most serious, in the Philippines is the so-called bunchy-top (fig. 5.) Abacá, like the sugar cane,

is cross-pollinated and propagated commercially in a vegetative way, and it is believed that the production of seedling varieties resistant to diseases as applied and found successful in the case of sugar cane may also be successfully applied to abacá. For this reason we began in this College in 1920 the production of abacá seedlings. The seedlings which have been produced have to be tested for resistance to bunchy-top, the most serious malady of the abacá considered to be a virus disease.[2] Data on the first batch of abacá seedlings produced here have been published in *The Philippine Agricultural Review*, Vol. XVI, p. 85–99, 1923. Another batch of seedlings was produced and since April, 1925, they are being tested for

Fig. 4.—Hybrid sugar cane seedlings raised for disease resistance ready to be shipped from the College nursery to Del Carmen, Pampanga.

resistance to bunchy-top. This test has been facilitated by the discovery made in this College in June, 1925, that in our plantations, aphids (*Pentalonia nigronervosa* Coq.)[3], are usually found on banana and abacá plants attacked by bunchy-top.

CITRUS (CITRUS SPP.)

Since 1918 the Department of Plant Pathology of the College of Agriculture at Los Baños has been collaborating with the Division of Crop Physiology and Breeding Investigations, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C., in experiments to find the relation to the citrus canker of citrus species, varieties, and relatives.

[2] Ocfemia, G. O. Progress report on bunchy-top of abacá or Manila hemp. Phytopath. In press, to appear in volume 16.

[3] Determined by Dr. L. B. Uichanco of the Department of Entomology.

The citrus canker caused by *Bacterium citri* (Hasse) Jehle *Phytomonas citri* (Hasse) Com. S. A. B., is the most destructive disease of citrus known in the United States and elsewhere. Dr. Walter T. Swingle, the Physiologist in Charge of the Citrus Investigations, placed one of the tropical stations of the United States Department of Agriculture at the College of Agriculture at Los Baños. Many citrus species, varieties, and relatives were planted in the orchard of the College of Agriculture. The observations of the relation to the citrus canker of the various citrus species, varieties, and relatives were first made by Dr. Otto A. Reinking, formerly Professor and Head of the Department of Plant Pathology and collaborator of the United States Bureau of Plant Industry. This investigation was undertaken by Doctor Swingle because a knowledge of the susceptibility of the various citrus species, varieties, and relatives is of the utmost importance in the production of disease resistant plants by hybridization. Our Department of Plant Pathology found that the following species of citrus are attacked by the citrus canker. The species are arranged in the descending order of their susceptibility:

Fig. 5.—Left, a young and healthy abacá plant (*Musa textilis* Née) showing the tapering pseudo-stem, leaves which are set farther apart and the gradually increasing size of the leaf blades. Note that the leaf blades are wide open. Right, a young abacá plant with the early stage of bunchy-top infection showing an abnormally large number of closely set leaves. Note that the pseudo-stem is short and of a uniform diameter from the foot to the base of the petioles. The leaves present a more or less rosette arrangement. The leaves, instead of increasing in size from the outside, inward, show a tendency to become narrower and the margin more or less curled upwards.

1. *Citrus maxima* (Burm.) Merr. *C. grandis* Osbeck
2. *C. aurantifolia* (Christm.) Swingle
3. *C. aurantium* L.
4. *C. limonia* Osbeck
5. *C. hystrix* DC.
6. *C. sinensis* Osbeck
7. *C. medica* L.
8. *C. medica* L. var. *sacrodactylis* Swingle
9. *C. nobilis* Lour
10. *C. nobilis* Lour. var. *unshiu* Swingle
11. *C. nobilis* Lour. var. *deliciosa* Swingle
12. *C. mitis* Blanco

Doctor Reinking noted that different varieties in the same species showed varying degrees of susceptibility to citrus canker. Young plants were more severely infected than older ones.

The following citrus relatives growing in the College of Agriculture were found resistant to citrus canker under field conditions:

1. *Aegle marmelos* Correa
2. *Aeglopsis chevalieri* Swingle
3. *Balsamocitrus gabonensis* Swingle
4. *B. paniculata* Swingle
5. *Severinia buxifolia* Ten.
6. *Xanthoxylum avicenœ* L.

The following citrus relatives which were found resistant to the canker under field conditions would take the disease if artificially inoculated with the citrus canker organism:

1. *Atalantia citrioides* Pierre
2. *Balsamocitrus dawei* Stapf.
3. *Chætospermum glutinosa* (Merr.) Swingle
4. *Chalcas exotica* Millsp.
5. *Citropsis schweinfurthii* Swingle and M. Kellerman
6. *Clausena lansium* Skeels
7. *Eremocitrus glauca* (Lindl.) Swingle
8. *Feronia limonia* (Corr.) Swingle
9. *Feroniella lucida* Swingle
10. *Fortunella hindsii* (Oliver) Swingle
11. *F. japonica* Swingle
12. *F. margarita* (Lour.) Swingle
13. *Hesperethusa crenulata* Roem.
14. *Microcitrus australasica* (Muell.) Swingle
15. *M. garrowayi* (Bail.) Swingle
16. *Paramignya monophylla* Wight
17. *Toddalia asiatica* (L.) Kurz.
18. *Triphasia trifolia* P. Wilson

In this work Doctor Reinking noted that the mandarin orange (*Citrus nobilis* Lour.), the most commonly cultivated species, is relatively free from citrus canker except when the plants are young and are planted in nursery rows. He suggested that mandarin or calamondin orange would probably give the best results if used as one parent of the cross when breeding for canker-resistance. He also suggested the use of citrus relatives in obtaining crosses.

The mandarin, as a species, is seldom killed by canker. For this reason, old plantations of mandarin and the scattered pummelo and other citrus plants are comparatively safe from this enemy.

A good deal of hybridization work has been done by Doctor Swingle of the United States Department of Agriculture with the aim of producing citrus varieties that will be immune to canker and at the same time commercially important, but the work has failed from the viewpoint of adaptability of the hybrids to Philippine conditions. This work consisted in hybridizing commercially important varieties susceptible to the canker with varieties resistant to the disease. The hybridization was performed outside the Philippines. The F_1 plants obtained are budded or grafted to hasten results. Many of these hybrid plants brought here in 1916 and 1917 were tested in this country in co-operation with this College. It was quite fortunate for the Philippines that the test was performed in this country, since the work is of tremendous importance and significance for the Philippines and costs the Philippine Government practically nothing. The test of the hybrids for canker is very rigorous, there being three or four tests made before a variety is declared resistant. The first test consists in observing monthly and then every other month which plants take the disease naturally and which do not. In this way a large portion of the plants under test are eliminated. Those that do not take the disease in the first test are artificially inoculated with the organism by applying pure cultures on the surface of the leaves. This test also eliminates some of those which are not infected by the canker, even after this method of inoculation is used the hybrids are tested for the third time by performing the artificial inoculation after needle pricks are made on the leaves. It is found that some plants which do not otherwise acquire the disease get it with this treatment. This kind of inoculation is considered necessary, since in nature, citrus leaves of spiny varieties are pricked with the spines on the trunk and branches and in this way wounds are produced on the leaves for the entrance of the causal organism. Plants which stand this third test are considered fairly immune to the canker, but the final outcome of the test is not known until such plants have been re-inoculated and re-exposed to the disease several times. Many hybrids have been tested on the College grounds and as a rule they do not grow well. Very many have died. Several have fruited, one is like the native calamondin (*C. mitis* Blanco) and the other is a mandarin, but both bear fruit of poor quality. There are two trees, however, which so far have not shown symptoms of canker. One is a hybrid between lime and kumquat and is called limequat, the other is a hybrid between the citrange and kumquat and is called citrangequat. These hybrids are growing on grapefruit stocks raised in the United States.

Doctor Reinking further found in this work that a *Diplodia*, perhaps identical with *D. natalensis* Pole Evans, is the cause of bark rot, fruit rot, and gummosis of citrus. The bark rot disease attacks practically all citrus species and citrus relatives as well.

In a study of the *Phytophthora* blight of citrus due to *P. faberi* Maubl. conducted by the Department of Plant Pathology from 1923 to 1925 it was noted that the following varieties are attacked by the disease in degrees indicated opposite each:

Citrus nobilis Lour. with severe infection
C. limonia Osbeck with medium infection
C. maxima (Burm.) Merr. with medium infection
C. aurantium L. with slight infection
C. medica L. with slight infection
C. aurantifolia (Christm.) Swingle with very slight infection
C. mitis Blanco with practically no infection

BANANA (MUSA SAPIENTUM L.)

The most immediately important disease of banana today is the Panama, or wilt disease (fig. 6) due to *Fusarium cubense* E. F. Smith, which now threatens to destroy the banana plantations of the banana exporting countries. The disease is prevalent in the Philippines and attacks our most important variety, the Latundal.

Fig. 6.—Stem of banana (*Musa sapientum* L.) variety Latundal showing the splitting of the pseudostem one of the most reliable symptoms of Panama, or banana wilt infection.

In April, 1925, the Department of Plant Pathology started work on the resistance of Philippine commercial varieties of bananas to the Panama, or wilt disease in co-operation with banana growers in Lalakay, Los Baños, Laguna. The Panama, or wilt disease, appeared in the banana plantations in Lalakay and threatened to devastate entire fields. The only promising control in the Philippines for this most destructive disease of the banana is the isolation of resistant Latundal strains or the production of resistant hybrids. Latundal is commonly planted in Lalakay and it is the most susceptible variety known. Other varieties as Lacatan, Buñgulan, Gloria, Morado, and Saba are less affected. The work on the development of wilt-resistant banana is in progress and it is expected that in the course of time a variety or strain of a variety highly resistant to the wilt disease will be isolated.

Much work, however, has yet to be done, for this banana problem is somewhat complicated by the fact that the commercial varieties of banana, which have to be used in the breeding work, are seedless. The Latundal, which has to be one of the parents, is seedless. The Buñgulan, Gloria and Morado, which have to be used as the other parent are also seedless. It will have to be decided whether two seedless varieties will produce seeds when crossed or how they can be crossed and made to produce seeds. It is thus necessary to study first the relation of seediness or seedlessness of banana to self- and cross-pollination and possibly to other physiological points. A start was made in this direction a few years ago and already some interesting results have been obtained (fig. 7). We have found for example that in a seeded variety the flowers need to be pollinated in order that the fruits may develop to the normal size. We also know that seedling bananas are being produced in nature although these seedlings are mostly of the Butuhan parentage.

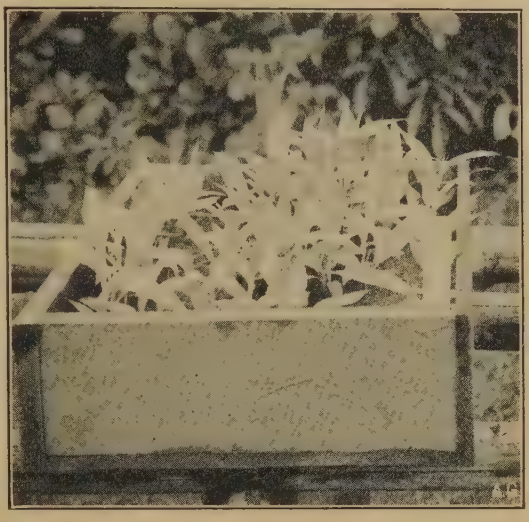

Fig. 7.—Young banana seedlings.

COFFEE (COFFEA SPP.)

It is well known that the coffee rust, due to *Hemileia vastatrix* B. and Br. is the worst enemy of coffee and that different species vary in their resistance to this disease. The cause of the susceptibility of *C. arabica*, for example, and the comparative resistance of *C. robusta* and *C. liberica*, is not known. As a preliminary step in the direction of breeding coffee highly resistant to this rust, this College imported into its cultures different foreign species. Later, the Department of Plant Pathology and the Division of Coffee and Cacao started in 1924 the determination of the cause of rust resistance and susceptibility. This work is in progress.

VEGETABLES

One of the most serious diseases of plants found in vegetable gardens in the Philippines is the bacterial wilt which attacks tomato, eggplant, and pepper. One of the most important pieces of work of the Department

of Agronomy in vegetable gardening is to introduce different varieties of these plants from various Philippine and foreign sources and to test their field resistance to this wilt. Already Mr. Dawis, who is in immediate charge of our vegetable gardens, has tested no less than six varieties of tomato,twelve of pepper, and six of eggplant. Unfortunately no variety has been found absolutely resistant to this disease. However, a variety of pepper, named Bolivian, given by Dean Baker to the Department, while also attacked by the wilt, is more resistant than the others which have been grown. In the case of the tomato we have at least established the fact that the native tomatoes and eggplants are more resistant to this disease than the several foreign kinds that we have handled.

In 1920 an advanced student in Plant Pathology worked on the possibility of isolating a rust resistant soybean. He tested the resistance of eight varieties. One of our most important root crops and vegetables is the sweet potato. We have a number of native varieties and have important different kinds from Java and the United States. From the latter country we have, especially, the "Jersey" potatoes, the Big Stem and the Yellow Jersey. In point of sweetness, the Yellow Jersey is superior to many of the native varieties. However, the Yellow Jersey is very susceptible to the stem rot disease while the native kinds are not. In the breeding work in sweet potato started in this College in 1919, one of the objects aimed at was to obtain a hybrid resistant to the stem rot. In this connection, co-operation work was started with the Assistant Plant Pathologist of the New Jersey Agricultural Experiment Station. Seeds were sent to him in 1922 and we expect to go on with this work whenever time permits.

PINEAPPLE (ANANAS COMOSUS (L.) MERR. A. SATIVUS SCHULTES)

The principal object of the pineapple hybridization work which was started in this College in 1922, was to obtain a hybrid which is resistant to the pineapple wilt and fruit rot diseases. The most successful foreign variety here, the Smooth Cayenne, is very susceptible to these diseases while the native Red Spanish is resistant. It is desired to have a Smooth Cayenne strain which has the disease resistance of the Red Spanish. Of the hybrids produced in 1922, eleven have already fruited and one or two are very promising from the viewpoint of the fruit. These eleven are those bearing the pedigree numbers 15, 16, 17, 18, 19, 20, 21, 23, 26, 28 and 29. One year hence these hybrids will have been propagated sufficiently to allow artificial inoculation with the wilt and rot organisms and the determination of the resistance of the plants to the attack of these enemies.

MAIZE (ZEA MAYS L.)

Another very important work conducted in the College of Agriculture at Los Baños and financed by the Federal Government of the United States was that of Dr. William H. Weston, Jr., in 1918. Doctor Weston was then

Plant Pathologist in Charge of the Downy Mildew Investigations of the Bureau of Plant Industry, United States Department of Agriculture. In his work, Doctor Weston found that representative varieties of all types of maize are very susceptible to the downy mildew caused by *Sclerospora philippinensis* Weston. Teosinte, maize-teosinte hybrids, and sorghum are attacked but less seriously. Many related plants, both cultivated and wild, were not infected even when artificially inoculated.

An advanced student in Plant Pathology found that imported varieties of maize are more susceptible to the leaf blight due to *Helminthosporium inconspicuum* Ellis and Evht. than the native and foreign but acclimatized varieties.

RICE (ORYZA SATIVA L.)

The work of an advanced student in Plant Pathology on the *Sclerotium* disease of rice due to *Sclerotium rolfsii* Sacc. was published in THE PHILIPPINE AGRICULTURIST in 1922. In this work it was found that only 21 out of 126 varieties of rice were not infected at all by the disease. Of those infected, varying degrees of susceptibility were exhibited. The varieties of rice which were found free from the disease follow:

Apostol
Caviteña
Darog (red)
Darog (white)
Dinumero
Kabago
Kaboong
Kalisod
Kanut
Kolilin
Lanioyo
Macan
Malati
Malinis
Mayoro
Minalet (pahule)
Mimis (pahule)
Palaypay
Panili
Saryaya
Sinampingit
Sinipulet
Tinalahib
Ubanan (A)
Ubanan (B)

The following varieties suffered the greatest damage:

Asucena
Binacal
Bumaro
Cabatiti
Castila a bii it
Cotanti
Ganado
Inatchupal
Itom
Itom (mabaska)
Iton magong balay
Lampakan
Legantong
Lumbang
Macan
Malagkit
Milagrosa
Seda

In a study of the *Helminthosporium* disease of rice due to *Helminthosporium oryzae* Breda de Haan, which was started in the Department of Plant Pathology in 1918 and completed in the United States in 1923, different varieties of rice were found to exhibit different degrees of susceptibility to the disease.

AVOCADO (PERSEA AMERICANA MILL. P. GRATISSIMA GAERTN.)

Recent work of the Department of Plant Pathology has shown that the Mexican type of avocado is the most susceptible to the anthracnose due to *Glomerella cingulata* (Stonem.) S. and v. S. Cyrus, a West Indian type, is less susceptible and Bottle Neck, also a West Indian type, is the least susceptible to the disease.

In practically all plant disease investigations conducted in the Department of Plant Pathology the relation of varieties and species to the disease is always held in view, inasmuch as the control through disease resistance is the most economical and the results permanent.

SOME OF THE CONTRIBUTIONS BEARING ON BREEDING DISEASE RESISTANT CROP PLANTS PUBLISHED BY THE COLLEGE OF AGRICULTURE

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STUDIES ON THE NUTRITIVE PROPERTIES OF SEAWEEDS[1]

ESTEBAN G. COLLADO

WITH THREE TEXT FIGURES AND FIVE CHARTS

INTRODUCTION

Seaweeds abound on the rocky coasts of the Philippines and are found to some extent in brackish streams. Several varieties are edible. In the northern provinces of Luzon bordering on the west coast, seaweeds are used as food. The inhabitants of the Bicol region also use seaweeds as food, with a particular liking for a certain variety belonging to the *Caulerpa* group. In the Visayan Islands and on the sea coasts of Mindanao, several edible varieties of seaweeds are found. They are used for food by inhabitants of these regions. Commonly, seaweed is boiled and mixed with vegetables. In Ilocos, Cagayan, and La Union provinces, it is eaten raw as a salad. In all probability, it is eaten in this form in other regions also.

The following are some of the edible varieties found in Ilocos and Cagayan provinces:[2]

Acanthophora orientales, culot (Il.)[3]
Caulerpa racemossa var. *uvifera*, ar-arusip (Il.)
Caulerpa sertularioidis, salsalamagui (Il.)
Caulerpa Freycinetti, galgalacgac (Il.)
Caulerpa (probably *C. peltata*, but possibly a form of *C. Chemnitzia*)
Chaetomorpha, ri-rippiis (Il.)
Enteromorpha, lumot (Il.)
Gracilaria (of the *G. confervoides* group), guraman (Il.)
Gracilaria lichenoides (?), gargararao (Il.)
Gracilaria, galgalacgac (Il.)
Hydroclathrus cancellatus, balbalulang (Il.)
Hypnea (near *H. nidifica*), culot (Il.)
Hypnea, guraman (Il.)
Sargassum, aragan (Il.)

Some of the edible varieties found in La Union (Seale, 1911) are:

Aghardiella sp. (*Fucus gulaman* Blanco), gulaman (Tag.). This species is common in Manila Bay
Chætomorpha crassa (Ag.) Kütz., cauat-cauat (Il.)
Codium tenue Kütz., pupu-lo (Il.)

[1] Thesis presented, 1923, for the degree of Master of Science in Agriculture from the University of the Philippines, No. 227; Experiment Station contribution No. 373.

[2] These varieties were identified by Dr. W. A. Setchell of the University of California to whom thanks are due.

[3] "Il." Ilocano dialect.

Enteromorpha intestinales
Eucheuma spinosum (L.) J. Ag., rupruppuuc (Il.)
Gracillaria confervoides L. Grev., gulaman
Gracillaria crassa Harv., susueldot-baybay (Il.)
Halymenia formosa Harv., gamet (Il.)
Liagora cheyneana Harv., baris-baris (Il.)
Sargassum siliquosum J. Ag., aragan (Il.)

Seaweeds are used as food also in China, Japan, and Hawaii (Reed, 1906), and other countries. The following is a list of edible algæ of Hawaiian Islands (Reed, 1906):

Scientific names	*Hawaiian names*
Ahnfeldtia concinna J. Agh.	Limu akiaki, or limus eleau
Amansia glomerata Ag.	Limu lipepeiao, or limu pepeiao
Asparagopsis sanfordiana Harv.	Limu kohu, limu lipaakai, limu lipehu, limu koko
Centroceras clavulatum (Agh.), Mont.	Limu huluilio, limu hulu, or limu hulu wawaei-iole
Chætomorpha antennina (Bory.), Kuetz	Limu huluilio, limu ilio, or limu manu
Champia compressa, Harv.	Limu oolu
Chnoospora fastigata pacifica, J. Ag.	Limu wawahiwaa, or limu kaupau
Chondria tenuissima intermedia	Limu oolu
Chylocladia rigens (?)	Limu akuila, or limu kihe
Cladophora nitida Kuetz	Limu huluilio
Codium muelleri, Kuetz.	Limu aallaula, limu wawaeiole, or limu wawaimoa
Codium adhaerens (Cabr.), Agh.	Limu aalaula
Codium tomentosum (Huds), Stackh.	Limu aalaula
Dictyota acutiloba distorta	Limu alani, or false lipoa
Dictyota dichotoma	Limu alani, or false lipoa
Ectocarpus indicus (?)	Limu akaakoa, or limu huluilio
Ectocarpus sp. (?)	Limu akaakoa, or limu huluilio
Enteromorpha flexuosa (Wulf.), Ag.	Limu eleele, or limu pipilani

Gloess (1920) states that algae from which the salts of potassium, bromine, and iodine have been removed can replace oats in the diet of horses, and serve as feed for cattle, swine, and poultry when mixed with the ration. Beckman (1915) gives the analysis of seaweed as follows: Protein, from 5 to 6 per cent; fat, from 0.9 to 2.2 per cent; starch, from 8.4 to 13.9; crude fiber, from 5.4 to 6.4; ash, from 18.3 to 23.4; and potassium chloride, from 2.5 to 6.3 per cent. He states that the material is found desirable as a supplementary feed for poultry, growing swine, and horses.

Beckmann (1916) conducted feeding experiments with dogs and hens, giving these animals bread made from a mixture of finely ground seaweed, rye and potato flours. He said that during baking, the characteristic odor disappeared and the bread was found to possess good properties. Kylin (1918) examined various kinds of algæ for the presence of carbohydrates. Only two of the eight species of brown algæ (*Desmarestia aculeata* and *D. viridis*), were found to contain laminarin, a polysaccharid built up from dextrose and analogous to starch in the higher plants, and in all of the species the percentage of soluble carbohydrates was small. Four species of Florideæ were found to contain trehalose but not mannitol. *Cladophora rupestris* was found to contain 15 per cent soluble carbohydrates including sucrose and levorotatory polysaccharides resembling indulin.

Kylin (1913) found mannitol in several varieties of *Fucus* and *Laminaria*, and small quantities of dextrose and levulose in several species of *Fucoideæ*, but none in the Florideæ. He found that some of the *Fucoideæ* contain laminarin also.

The Florideæ contain starch which gives dextrose when boiled with dilute acids and is quickly hydrolyzed by malt diastase. Bruyn (1918) gave the composition of *Zostera marina* as follows: Albuminoids, 20.6; true albumin, 16.9; digestible albumin, 4.2; fat, 1.6; starch, 38.6; crude fiber, 14.8; ash, 24.4; and NaCl, 12.7 per cent. He suggested that before drying, salts be removed with soft water. He states that if hard water were used, algin, a mucilaginous, nitrogenous substance occurring in many seaweeds will form, with calcium and magnesium, insoluble compounds which would diminish the food value.

Swartz (1913) studied the carbohydrates of the following species of seaweeds: the pentosans of dulse (*Rhodymenia palmata*), limu (*Haliseris pardalis, Ulva lactuca laciniata, U. fasciata*); the galactans of Irish moss (*Chondrus crispus*), limu (*Gracilaria corenopifolia, Hypnea nidifica, Ahnfeldtia concinna, Gymnogongrus vermicularis amer., G. disciplinalis, Asparagopsis sanfordiana*), elm (*Ulmus fulva*); the mannan of salep (*Orchis* and *Eulophia*); the levulan of sinistrin (*Urginia*, or *Scilla maritima*). She found that the hemicelluloses of the ten species of marine algæ are chiefly pentosans and galactans. The pentosans are largely insoluble in water and the galactans are soluble in hot water and are gelatinous. The hemicelluloses are resistant to bacterial action in the following relative order: galactans, pentosans, levulans, mannans. The galactans of *Chonrus crispus* are entirely unaffected. Aerobic and anærobic bacteria from soil and feces, and *B. anthracis symp.* and *B. maligni œdomatis* produced reducing sugar from salep mannans. The last two were found to reduce pentosans of dulse, also. Digestion experiments in vitro with human saliva, malt, and taka diastase, dog and pig pancreas extracts, dog intestinal extract and pig stomach extract were conducted and none was found to give enzymatic action on the carbohydrates. Parenteral introduction of these hemicel-

luloses was followed by their complete and unchanged elimination in the urine. The pentosans of dulse and mannan of salep gave an average coefficient of digestion of 99 per cent in human, less in dog. The galactans are digested in man to approximately 25 per cent and in dogs to about 45 per cent.

Albert and Krause (1919) investigated German seaweeds and state that all kinds of these seaweeds seem to be valuable for cattle feed. *Laminaria saccharina* resembles spinach when cooked and can be used for cattle in times of scarcity of other feeds.

Seaweeds play an important part in the manufacture of iodine. Doherty (1919) found that the large brown variety of *Laminaria* identified as *Ecklonia radiata* contains iodine in the following amounts: fresh weed, 0.06; dry weed, 0.40; ash, 1.5 per cent. Dry seaweeds from other sources (coasts of Scotland, Ireland, Spain, and France) contain iodine as follows: *Laminaria digitata*, 0.45 per cent; *L. stenophylla*, 0.48 per cent; *L. saccharina*, 0.28 per cent; Japanese edible seaweed, 0.31 per cent.

Wells (1916) found that gulaman dagat, which is marketed in the Philippines as a cheap substitute for gelatin when sun-bleached and dried, contains less than 1 per cent N, while gelatine contains about 17.9 per cent N. Gulaman dagat is equally low in all other nutritive constituents, and can be used as a substitute for gelatin only when the physical properties of the latter are under consideration.

Adrian (1918) analyzed seaweed which had been treated to remove the excess of salts and found the following: water, 14.5 per cent; carbohydrates, 53 per cent; nitrogenous matter, 17.3 per cent; cellulose, 11.5 per cent; mineral salts, 3.9 per cent. A feeding experiment with horses afflicted with lymphangitis resulted in the cure with an increase in weight of the animals that received the seaweeds; the control animals remained sick. Adrian fed a group of twenty cavalry horses with seaweed in place of the regular oat ration; at the end of two months the horses fed with seaweed were in better shape and had gained more weight than the control group of twenty horses that received the oats. Bark, Lenz, and Zuntz (1916) claimed that seaweeds with the adherent mussels, etc., form excellent fodder for pigs.

The foregoing review shows that seaweeds are being used quite extensively as food and to a limited extent as medicine. In view of its use as food and its abundance, it was thought that a study of the nutritive properties of the edible varieties used in the Philippines was desirable. Hence, the following investigation was carried out in the College of Agriculture from 1920 to 1923.

MATERIALS AND METHODS

The method used was biological. The seaweeds, either alone or with some supplement, were given to animals and the nutritive effect noted.

Three seaweeds were used in this investigation. The first was collected from a brackish stream in Buguey, Cagayan, and is known as guraman (*Gracilaria* of the *G. confervoides* group). It grows in shallow muddy water from one-half to one meter deep. In Buguey this seaweed covers an area of about five hectares. The people from the neighboring towns and sometimes sailors and merchants from the Ilocos provinces go there for the purpose of gathering this alga. Guraman grows only during the dry season. In January, new vegetative growth appears and is ready for table use in

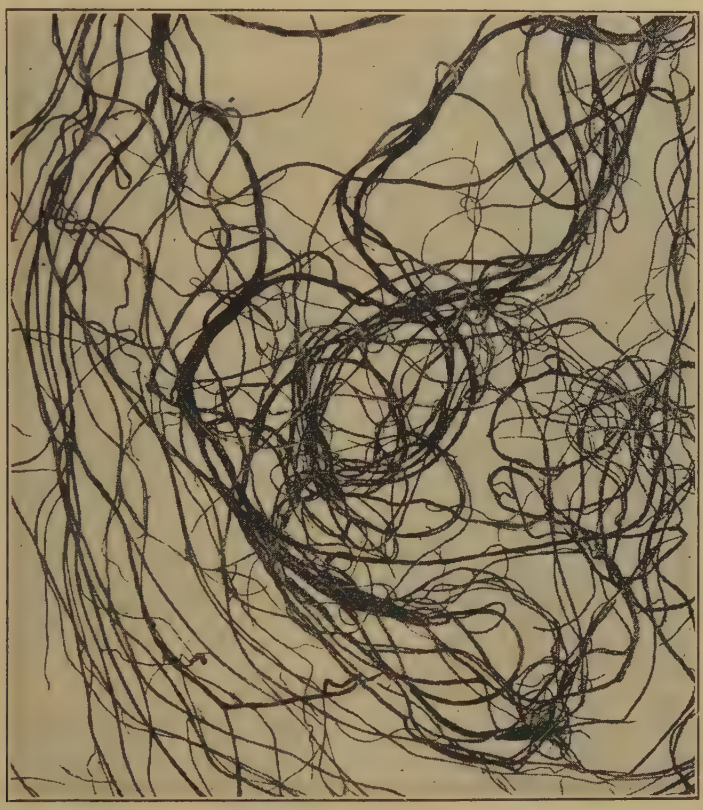

Fig. 1.—Guraman (*Gracilaria* of the *G. confervoides* group)—S1.

about three months. When from three to five months old, it is at its best stage for food. This alga totally disappears from September up to December owing to the frequent rainfall which freshens the water, thus making it very unfavorable for development of the plant.

The second seaweed used is known in Ilocos provinces as culot (*Laurencia*). It grows on rock in the surfs and can be gathered only at low tide. It is found throughout the year but is more common during the dry season.

The third seaweed is known in Ilocos as aragan (*Sargassum*——). It grows in the same places as culot, but is abundant only in crevices where it is continuously reached by waves. It grows throughout the year. This seaweed is tough and is seldom used for food.

For convenience these materials were given the symbolic names S_1, S_2, and S_3. S_1 stands for guraman (*Gracilaria* of the *G. confervoides* group), S_2, for culot (*Laurencia*), and S_3, for aragan (*Sargassum*——).

These three seaweeds were analyzed in the Experiment Station Food Laboratory of this College. The results of the analyses together with that of other food materials used in the investigations are given in table 1.

TABLE 1

Showing chemical composition of seaweeds studied and of other materials [a]

MATERIALS	MOISTURE	PROTEIN	ETHER-FREE EXTRACT. (CARBOHYDRATES ETC.)	ETHER EXTRACT (FAT)	CRUDE FIBER	ASH	IODINE
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Seaweed, S_1	15.73	5.00	60.96	1.17	6.70	6.82	0.020
Seaweed, S_2	9.33	8.62	53.79	1.21	8.38	18.66	0.439
Seaweed, S_3	33.44	5.01	30.24	1.29	5.13	24.89	0.390
Copra meal[b]	11.3	20.1	37.3	12.2	13.3	5.5	
Rice[c]	13.11	7.85	77.15	0.88	——	1.01	
Corn meal	13.88	8.90	67.28	4.47	2.86	2.61	
Mixed feed[d] (Normal diet)	22.13	8.39	56.31	6.69	2.06	1.40	

a Air dry materials.

b Analysis quoted from *Philippine Journal of Science* **16**: 181–189. 1920.

c Analysis quoted from *Philippine Journal of Science*, Sec. A, **7**: 383–398. 1912.

d Constituents of mixed feed (normal diet): Rice, 60 grams; corn, 30 grams; casein, 5 grams; salt mixture, 2 grams; fresh milk, 10 cc.

The animals employed in this work were guinea pigs and white rats. The guinea pigs were obtained from the College of Agriculture stock. Young and healthy animals were selected. They were divided into lots of two animals each, a male and a female. The rats were the offspring of the six original rats given to the College of Agriculture by Professor Laird of Canton Christian College. Rats from the same litter were chosen whenever possible. They were kept separately in cylindrical wire cages similar to the rat cage for nutrition experiments used by Osborne and Mendel (Ferry, 1920). During the course of the experiment the male and female rats in the same lot were placed together occasionally to breed.

The supplementary feed materials used for the preparation of the rations were copra meal, casein, butter fat, corn starch, rice, guinea grass, and salt mixture 308 of McCollum and Davis (1915).

Preparation of the feed

Seaweeds. The seaweeds were washed with fresh water, dried in the sun, then ground through a meat grinder.

Copra meal. The copra meal was obtained from the Animal Husbandry Department. It was ground through a meat grinder before using.

Casein. The casein was ground fine through a grinding machine. The casein used for the preparation of vitamin B-free ration was washed ten times with rain or distilled water and dried in the sun before being ground.

Fig. 2.—Culot (*Laurencia*)—S_2.

Fig. 3.—Aragan (*Sargassum* sp.)—S_3.

Rice. The polished rice was finely ground through the grinding machine. In the preparation of basal ration for the determination of water soluble B, the rice was repolished by passing the grains through a meat grinder two or three times. To remove polishings, the ground rice was sifted through a fine sieve. Then the rice meal was ground into flour.

Rice bran water extract. The rice bran water extract was prepared by soaking bran, free from other impurities, in water for about twelve hours. The liquid was separated from the solid by filtration through cloth. The clear liquid was decanted and then evaporated on a water bath to a syrup. This extract was used as a source of water soluble B.

EXPERIMENTAL

Effect of seaweed S_1 on guinea pigs

Experiment 1. This experiment was conducted to find whether seaweeds can sustain the life of guinea pigs when used as the only diet. On July

27, 1920, two guinea pigs 1 ♂ and 2 ♀ were started on a diet of seaweed. Tap water was given *ad libitum*. The initial weight of 1 ♂ was 481 grams, and of 2 ♀, 506 grams. By the fifth day, both animals looked very weak. The coat became rough and the back arched. At the end of a week, the male had lost 145 grams, and the female, 121 grams. Guinea pig No. 1 ♂ died on the eighth day and 2 ♀ on the ninth day.

Experiment 2. To find the effect of seaweed when supplemented with a concentrated feed, another experiment with two other animals was begun at the same time as experiment 1, using copra meal as supplement. Both feeds were given *ad libitum*. The initial weight of guinea pig No. 3 ♂ was 380 grams and of 4 ♀, 337 grams. With this ration the animals were not able to maintain their weights. They were active for the first three weeks but became weaker after the fourth week. The hind legs of the female became stiff and she was not able to stand. On the twenty-eighth day, 4 ♀ died and on the thirtieth day 3 ♂ died, the weight of 3 ♂ at death was 175 grams, and of 4 ♀, 160 grams.

Experiment 3. Feeding began January 18, 1921: Daily ration: seaweed *ad libitum*, guinea grass (*Panicum maximum*, Jacq.) 20 grams daily. Initial weights: animal 5 ♂, 380 grams, and animal 6 ♀, 366 grams. Both animals decreased in weight, but appeared healthy. On the fifth day, animal 6 ♀ was found dead with its intestine missing, having been eaten by animal 5 ♂. On the eighteenth day, animal 5 ♂ died; its weight after death was 287 grams. It is interesting to note that animal 5 ♂, after the death of 6 ♀ did not eat seaweed. It is possible that even before the death of its companion this animal was not eating any seaweed.

Experiment 4. Feeding began January 18, 1921. Daily ration: seaweed *ad libitum*, guinea grass 50 grams daily. Initial weights: animal 7 ♂, 293 grams, animal 8 ♀, 307 grams. During the course of the experiment, a gradual weakening of the animals was observed. Animal 7 ♂ died on the tenth and 8 ♀ on the fifteenth day.

Experiment 5. Feeding began January 18, 1921. Daily ration: seaweed *ad libitum*, and guinea grass 100 grams. Initial weights: animal 9 ♂, 356 grams, animal 10 ♀, 254 grams. Animal 10 ♀ died on the seventh day, weighing 198 grams after death, and animal 9 ♂ died on the seventeenth day, weighing 277 grams after death.

Experiment 6. Feeding began February 9, 1921. Daily ration: seaweed *ad libitum*, and artificial food mixture A[3], *ad libitum*. Initial weights: animal 11 ♂, 548 grams, and animal 12 ♀, 482 grams. In the first week, both animals lost in weight rapidly. When it was found that they could not subsist on this ration, they were given their normal diet of grass and copra meal, both *ad libitum*. Recovery did not follow the change in diet, both animals died one week later.

[3]Composition of artificial food mixture A: Dextrin, 60 grams; casein, 24 grams; butterfat, 8 grams; salt mixture, 5 grams; rice bran extract, 10 grams.

Effect of seaweed S_2 on guinea pigs

The experiments conducted with this seaweed were on exactly the same plan as with seaweed S_1. The experimental results follow:

Experiment 7. Feeding began July 27, 1920. Daily ration: seaweed alone *ad libitum*. Initial weights: animal 13 ♂, 412 grams, and animal 14 ♀, 486 grams. After three days with this ration, the animals' hair became rough in appearance. Animal 13 ♂ died on the ninth day, weight after death 378 grams, and animal 14 ♀ on the thirteenth day, weight after death, 358 grams.

Experiment 8. Feeding began July 27, 1920. Daily ration: seaweed supplemented with copra meal, both given *ad libitum*. Initial weights: animal 15 ♂, 344 grams and animal 16 ♀, 329 grams. After a week on this feed, the animals become inactive and had difficulty in voiding their feces. Animal 15 ♂ died on the twenty-sixth day, weight after death, 197 grams, and animal 16 ♀ on the twenty-eighth day, weight after death, 204 grams.

Experiment 9. Feeding began January 18, 1921. Daily ration: seaweed *ad libitum*, and guinea grass, 20 grams. Initial weight of animal 17 ♂, 468 grams, and animal 18 ♀, 482 grams. The results from this experiment were similar to those obtained in experiment 3. Animal 18 ♀ died the seventh day, weight after death, 401 grams, and animal 17 ♂, the fourteenth day, weight after death, 341 grams.

Experiment 10. Feeding began, January 18, 1921. Daily ration: seaweed supplemented with guinea grass, 50 grams. Initial weights: animal 19 ♂, 355 grams, and animal 20 ♀, 362 grams. Animal 19 ♂ died on the fourth day, weight after death, 280 grams, and animal 20 ♀ on the fifth day, weight after death, 280 grams.

Experiment 11. Feeding began January 18, 1921. Daily ration: seaweed supplemented with 100 grams guinea grass. Initial weights: animal 21 ♂, 325 grams, and animal 22 ♀, 291 grams. The animals with this ration were able to live only a few days. Animal 21 ♂ died on the sixth day, weight after death, 285 grams, and animal 22 ♀ on the tenth day, weight after death, 274 grams.

Experiment 12. Feeding began February 9, 1921. Daily ration: seaweed supplemented with purified food mixture A. Initial weight of animal 23 ♂ was 504 grams, and of animal 24 ♀, 596 grams. The result in this experiment was similar to that obtained in experiment 6.

Effect of seaweed S_3 on guinea pigs

Experiment 13. Feeding began, February 6, 1923. Daily ration: seaweed supplemented with guinea grass, 20 grams. The result obtained from this experiment was similar to results obtained from seaweeds S_1 and S_2 supplemented with the same amount of guinea grass. Animal 25 ♂ died on the fifteenth day and animal 26 ♀, on the seventh day.

Experiment 14. Daily ration: seaweed supplemented with 50 grams of guinea grass. Animal 28 ♀ died on the seventh day. Animal 27 ♂, when near death was returned to the normal diet of grass and copra meal, both *ad libitum*.

Experiment 15. Daily ration: seaweed supplemented with 100 grams guinea grass. The effect of this ration was the same as that obtained in experiment 14. Animal 29 ♂ died on the seventh day, and animal 30 ♀ was returned to the normal diet.

Detection of the deleterious constituents of seaweed

It was shown in experiments 1–15, that seaweed could not support the life of guinea pigs even when supplemented with an artificially prepared food mixture deficient in antiscorbutic vitamin, or with guinea grass to the amount of from 10 to 50 grams per animal daily, or with an unlimited amount of copra meal. Experience in this laboratory has shown that guinea pigs can live normally on guinea grass alone. But as found in experiments 3, 4, 5, 9, 10, 11, 13, 14, and 15, guinea pigs fed on seaweed supplemented with guinea grass, from 10 to 50 grams daily, did not thrive well. From these results, it was suspected that there must be some deleterious substance or substances in seaweed responsible for the early death of the experimental animals.

If seaweed contains some deleterious substance, it was considered of interest to investigate whether this substance would have the same effect on other animals that it had on guinea pigs. With this object the following experiments with albino rats were conducted. Rations containing different proportions of seaweed were prepared.

Experiment 16. Rats 206 ♀, 208 ♀, 210 ♂, and 195 ♀ were given normal diet and fed as control. The body weight curves of the male and females (average) are given in chart 1.

Experiment 17. Ration A_1: seaweed S_1, 70 per cent; casein, 16 per cent; butter fat, 10 per cent; salt mixture, 4 per cent. To every 100 grams of this mixture one gram of rice bran water extract or 10 cc. tomato juice was added. Rats 165 ♂, 177 ♂, 172 ♀, and 173 ♀ were used. The feeding was started on July 27, 1922. The body weight curves of the animals are shown in chart 2–S_1.

Upon examination of the body weight curves of the different individuals, it may be seen readily that this ration is just enough to maintain their body weights. The rats were shaggy in appearance, physically weak and were not able to reproduce. During the fourth week of the experiment, a bloody area around the right eye of rat 177 ♂ was noticed. Five weeks after the disease was noticed, bulging of the eyeball was observed. Further physical examination disclosed the following: Purulent inflammation of the iris of the eye with opacity of the cornea; slight erosion of the cornea, with an acute conjunctivitis; blackened teeth. The animal was given at

once the normal diet but neither sight nor health was restored to eye. Three weeks later, the left eye was affected, probably from infection and the animal became totally blind.

In the fourth month the right eye of rat 172 ♀ was affected in a similar way and the animal became blind. The bulging of the eye which was noted in rat 177 ♂ did not occur in this animal.

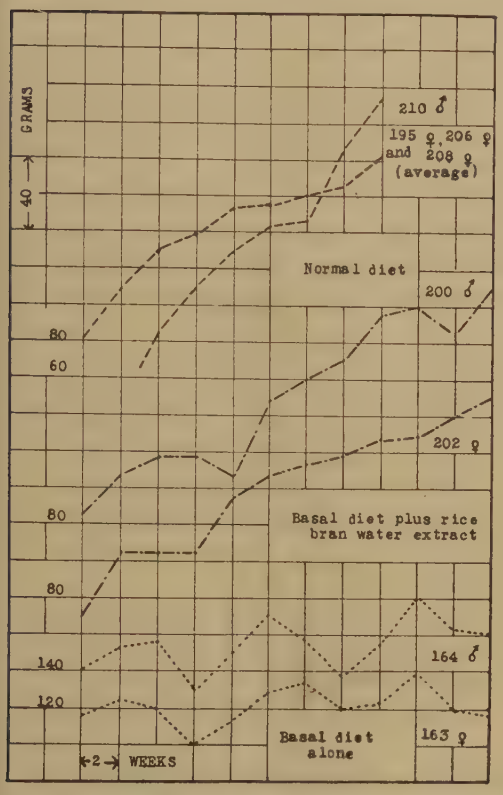

Chart 1.—Normal diet: rice, 60 grams; corn, 30 grams; casein, 5 grams; salt mixture, 2 grams; fresh milk, 10 cc. Basal diet: rice, 60 per cent; corn starch, 10 per cent; casein, 14 per cent; butter fat, 10 per cent; salt mixture, 4 per cent; filter paper, 2 per cent.

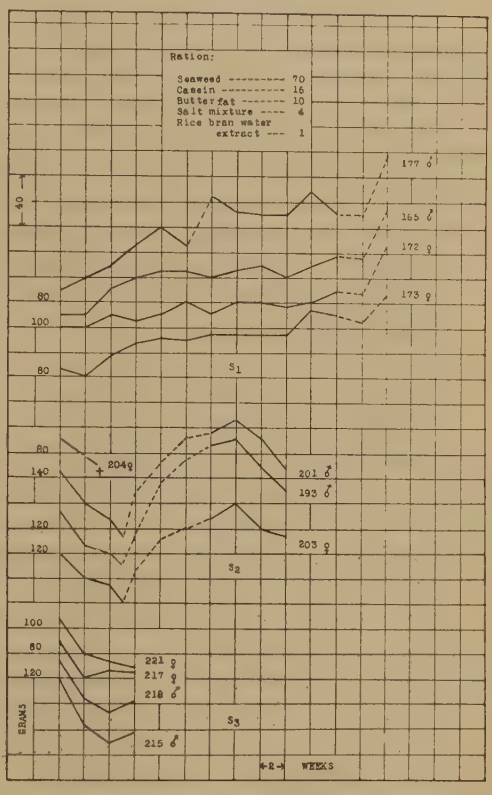

Chart 2.—Legend: ———— = Experimental diet; - - - - - - = Normal diet; ÷ = Animal died.

Experiment 18.—Ration A_2: seaweed S_2, 70 per cent; casein, 16 per cent; butter fat, 10 per cent and salt mixture, 4 per cent. One gram rice bran water extract was added to every 100 grams of the mixture. Rats 193 ♂, 201 ♂, 203 ♀, and 204 ♀, were used in this experiment. Feeding began October 14, 1922. Their body weight curves are shown in chart 2–S_2.

All the animals with this ration daily lost in weight and became greatly emaciated. In the third week, rat 204 ♀ died of pneumonia. In the fifth week, the supply of seaweed S_2 was exhausted and the remaining animals were given the normal diet. They increased rapidly in weight. They

remained on this diet until January 6, 1923, when a new supply of seaweed arrived, and they were again returned to the experimental feed. At first the animals increased in weight, then later, decreased.

Experiment 19. Ration A_3: seaweed S_3, 70 per cent; casein, 16 per cent; butter fat, 10 per cent, and salt mixture, 4 per cent plus one gram of rice bran water extract. Rats 215 ♂, 218 ♂, 217 ♀, and 221 ♀ were used. Feeding experiment was started on January 15, 1923. The body weight curves are shown in chart 2–S_3.

The animals on this ration lost weight, daily. During the fourth week, rats 217 ♀ and 221 ♀ looked very sickly so were given 5 cc. of milk daily in addition to the experimental feed. Both rats increased in weight, but lost as soon as the milk was withdrawn.

Experiment 20. Ration B_1: seaweed S_1, 20 per cent; rice, 50 per cent; casein, 16 per cent; butter fat, 10 per cent; salt mixture, 4 per cent. One gram rice bran water extract was added to every 100 grams of the mixture. Rats 144 ♂, 145 ♂, 174 ♀, and 175 ♀ were used. Their body weight curves are shown in chart 3–S_1.

The animals on this ration grew, but very slowly. They were able to reproduce. Rat 175 ♀ gave birth to a litter of five young on November 8, 1922. The young were able to grow normally for a period of about two weeks, then their growth rate was retarded. Three weeks after birth, two died; six days later, another one died. Only two young ones were successfully reared. On December 4, 1922, 174 ♀ gave birth to a litter of three young. One died at the age of five days, and another one at the age of sixteen days. The other one was successfully reared.

Experiment 21. Ration B_2: seaweed S_2, 20 per cent; rice, 50 per cent; casein, 16 per cent; butter fat, 10 per cent; salt mixture, 4 per cent. Rice bran water extract was added in the same proportion as in the other experiment. Rats 194 ♂, 207 ♂, 211 ♂, and 205 ♀ were used. Feeding was started on November 4, 1922.

Rats 194 ♂, 207 ♂, and 205 ♀ first lost in weight and then gradually improved. After a week on this ration, it was observed that the area around the anus of 205 ♀ was always watery. Fresh milk, 5 cc. daily, was given to this animal in addition to experimental diet, but she died in the third week. The rate of growth of rat 211 ♂ was even greater than the growth of rats in the control lot. The body weight curves of these animals are shown in chart 3–S_2.

Experiment 22. Ration B_3: seaweed S_3, 20 per cent; rice, 50 per cent; casein, 16 per cent; butter fat, 10 per cent; and salt mixture, 4 per cent. One gram rice bran water extract was added to this mixture. Rats 214 ♂, 220 ♂, 222 ♀, and 234 ♀ were used. The experiment was started on January 15, 1923. The body weight curves of these animals are shown in chart 3–S_3.

The animals on this ration grew normally.

Test for water soluble B

It is an accepted fact that the chemical analysis of a food material alone is not enough to show its dietary value. In addition to proteins, fat, carbohydrates, and inorganic salts, certain other dietary essentials have to be taken into account also. Since seaweed is used as a food, tests for its vitamin content is desirable. In the present work the test for vitamin B, only, could be made. A basal diet of the following composition and deficient in vitamin B was prepared.

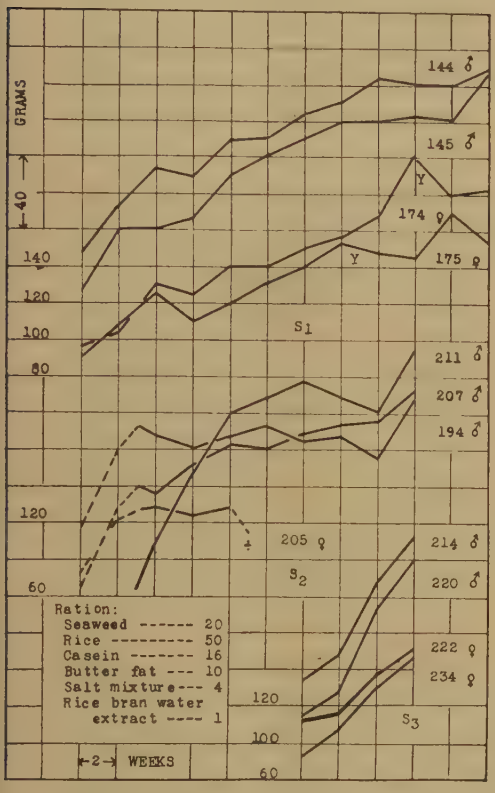

Chart 3.—Legend: ———— = Experimental diet; - - - - - - = Normal diet; Y = Birth of a litter of young; ÷ = Animal died.

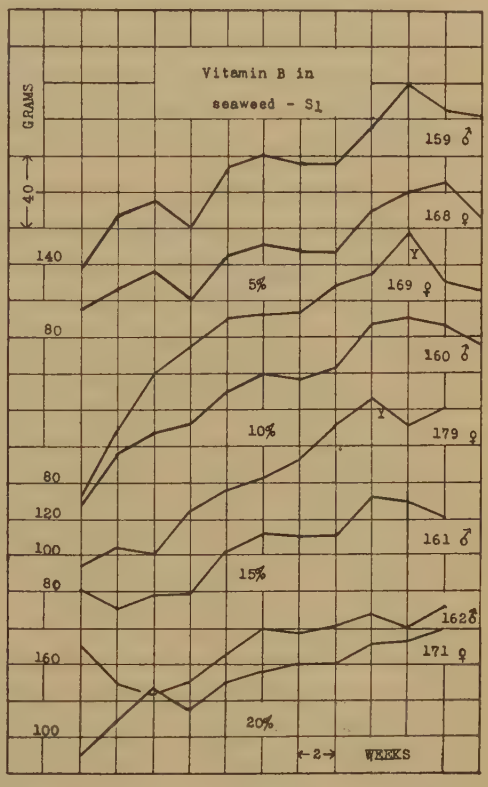

Chart 4.—Legend: Y = Birth of a litter of young.

Rice: 60 per cent; starch, 10 per cent; casein, 14 per cent; butter fat, 10 per cent; salt mixture, 4 per cent; and filter paper, 2 per cent. To this diet different amounts of the seaweed to be tested for vitamin B were added.

Experiment 23. In chart 1 the growth curves of rats 200 ♂, 202 ♀, 163 ♀, and 164 ♂ are shown. These animals were used as check. Rats 163 ♀ and 164 ♂ were fed with the basal ration alone. After about six months both rats weighed practically the same as at the beginning of the experiment. The animals were not active and did not reproduce although

they were kept together. Rats 200 ♂ and 202 ♀ were fed with a mixture of 95 per cent basal ration and 5 per cent rice bran water extract. It was found after the second week that the weight of the animals remained practically constant for some time. The female maintained constant weight for a period of four weeks and the male for two weeks and then decreased in weight the last two weeks. The rice bran extract used when their growth was arrested was heated directly in an open pan over a flame so as to evaporate the water. The water soluble B must have been partly destroyed in the preparation. When the rice bran water extract (evaporated on a water bath), prepared in the ordinary way, was added to the basal ration, normal growth was again resumed. The animals were healthy, but did not reproduce.

Experiment 24. Ration: 95 per cent of basal ration and 5 per cent seaweed S_1. Rats 159 ♂ and 168 ♀ were used. Feeding experiment was started on July 27, 1922. The curves of body weight are shown in chart 4. On this ration the animals were able to grow but at a very slow rate.

Experiment 25. Ration: seaweed S_1, 10 per cent; basal ration, 90 per cent. Rats 160 ♂ and 169 ♀ were used. Feeding experiment was started on July 27, 1922. The growth curves are shown in chart 4. These animals were able to maintain a steady increase in weight, but were rather below the normal. They were healthy and active and were able to reproduce. The female gave birth to a litter of five young on December 6, 1922. Two of these young died after birth, the rest lived for twenty days, but were shaggy and poorly developed.

Experiment 26. Ration: seaweed S_1, 15 per cent; basal ration, 85 per cent. Rats 161 ♂ and 179 ♀ were used. Feeding experiment was started on July 27, 1922. The body weight curves of the animals are shown in chart 4. The animals on this ration had about the same rate of growth as those in experiment 24. They were healthy and able to reproduce. The female gave birth to a litter of three young on December 4, 1922, all of which died the next day.

Experiment 27. Ration: seaweed S_1, 20 per cent; basal ration, 80 per cent. Rats 162 ♂ and 171 ♀ were used. Feeding experiment was started on July 27, 1922. The body weight curves are shown in chart 4. The animals on these rations were not as healthy as those in experiments 25 and 26. Their growth was greatly retarded. They were not able to reproduce.

Experiment 28. Ration: seaweed S_2, 5 per cent; basal ration, 95 per cent. The experiment was started on September 29, 1922. Owing to lack of seaweed, it was carried out for only about two months and a half. The curves of body weights of rats 199 ♂ and 180 ♀ are shown in chart 5. The male increased in weight continuously, but at a greatly retarded rate. The female maintained its weight.

Experiment 29. Ration: seaweed S_2, 10 per cent; basal ration, 90 per cent. The experiment was started on September 9, 1922. The body weight curves of rats 198 ♂ and 181 ♀ are shown in chart 5. The rats were able to grow on this ration. The male maintained about a normal rate of growth. The female, however, was able to gain a little in weight. The animals were healthy but were unable to reproduce.

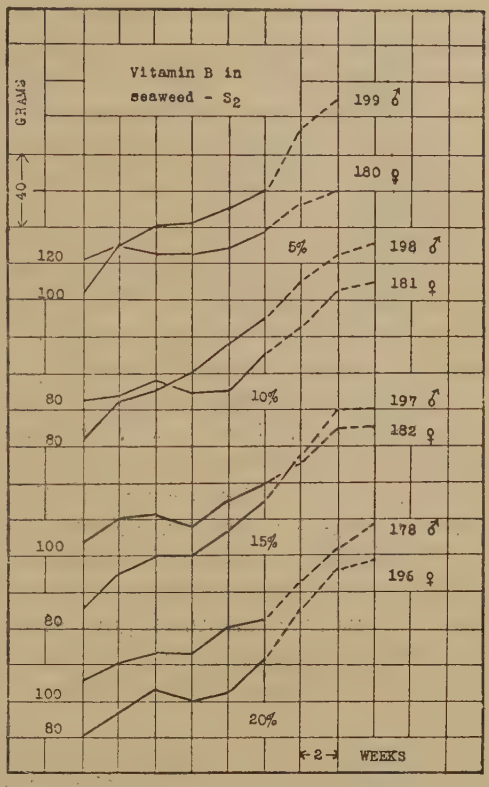

Chart 5.—Legend: ——— = Experimental diet
- - - - - - = Normal diet.

Experiment 30. Ration: seaweed S_2, 15 per cent; basal ration, 85 per cent. Rats 197 ♂ and 182 ♀ were used. Feeding was started September 9, 1922. The body weight curves of these animals are shown in chart 5. Comparing the growth of these animals with those in experiment 29, it may be seen that the rate of growth was practically the same. Both animals were healthy at the end of the experiment.

Experiment 31. Ration: seaweed S_2, 20 per cent; basal ration, 80 per cent. Feeding was started September 9, 1922. The growth curves are shown in chart 5. The rates of growth of rats 178 ♂ and 196 ♀ were poorer than those of experiments 29 and 30.

DISCUSSION OF RESULTS

Effects on guinea pigs

In experiments 1 and 7 it was shown that seaweeds when used as the only food can not support the life of guinea pigs. The daily seaweed intake of the animals in experiment 1 varied from 15 to 20 grams and in experiment

7 from 10 to 15 grams. The guinea pigs which ate the larger amounts of seaweed died sooner than those which ate less. Gloess (1920) found that algæ freed from the salts of potassium, bromine, and iodine can replace oats in diet of horses. These substances may be the factor responsible for the early death of the animals used in these experiments.

Copra meal was shown to be a good feed when supplemented with guinea grass in an unlimited quantity (Derecho, 1921). Seaweed was supplemented with copra meal with the object of determining whether or not these two food materials known to be deficient in some food factors can supplement each other. With this ration the animals were not able to live longer than four weeks, but they lived longer than those fed exclusively with copra meal (Derecho, 1921).

The leaves of plants are a good source of the unidentified dietary essentials or vitamins. Seeds and tubers when supplemented with greens are able to maintain normal growth of animals (McCollum, Simmonds and Parsons, 1919). Seaweeds were, therefore, supplemented with guinea grass in varying proportions, the natural feed of the guinea pigs.

The results obtained were no better than when seaweeds were fed alone. The animals were not able to live as long as the ones fed exclusively on guinea grass, although the amount of grass given to the latter animals was exactly the same as the amount supplemented to the seaweed. The duration of the life of the animals fed with different amounts of supplement was about the same.

The failure of the animal to live on the ration supplemented with guinea grass suggested the use of another supplement, an artificially prepared food mixture constituted to furnish all the requirements of the animals, except the antiscorbutic vitamin. On this ration the guinea pigs failed to thrive, and the ill effect of the diet was not removed by returning to the normal diet. The results tend to show that seaweed may be deficient in antiscorbutic vitamin or that it contains deleterious substances. The three kinds of seaweeds used had practically the same effect on guinea pigs.

Effects on white rats

In experiment 17 it was shown that animals with a ration of 70 per cent S_1, 16 per cent casein, 10 per cent butter fat, 4 per cent salt mixture plus rice bran water extract or tomato juice could hardly maintain their weights. Seaweed S_1 contains .02 per cent iodine.

Cameron and Carmichael (1920) in their experiment on thyroid feedings observed that a distinct and much decreased growth rate was shown, without exception, when animals were given thyroid glands in the proportion of 1 mgm. of dried thyroid to 5,000 mgm. body weight. The substances responsible for the inhibition of the growth rate was assumed to be the iodine content of the thyroid. Their daily dose is equivalent to .001 mgm. of iodine per 5,000 mgm. of body weight. On the ration given above,

the rats used in this work had an average daily intake of 15 grams seaweed, which gives them about .103 mgm. of iodine per 5,000 mgm. of body weight.

The iodine in the thyroid glands appears to be present in organic form and the activity of the thyroid is in proportion to the iodine content (Mathews, 1916). If the iodine of seaweeds were present in an organic form, as in the thyroid, then the amount of iodine furnished by the ingested seaweeds would have a fatal effect on the animal. Cameron and Carmichael (1920) fed NaI in varying quantities from amounts equal to the iodine content of the thyroid doses to amounts one hundred times as great and found no effect on growth rates. It is then possible that the iodine in seaweeds is present, at least partly, in organic form. Seaweed S_2, with an iodine content of 0.439 per cent, was used in experiment 18, and seaweed S_1 with 0.39 per cent iodine, in experiment 19. The animals in these two experiments suffered greater loss of weight than the animals in experiment 17.

The rats, the ration of which contained seaweed in smaller proportion (20 per cent), were able to grow normally (experiment 20). Assuming that iodine is really the deleterious substance in seaweed, it is seen that continuous small dosage of this element does not materially affect the growth of the animals (experiments 20, 21, 22). The animals in experiment 21 were on the average poorer than those in experiment 20. The iodine content of the seaweed used in experiment 21 is more than that of the seaweeds used in experiment 20. The growth of rat 211 ♂ (experiment 21) was greater than that of rats 210 ♂, 195 ♀, 206 ♀ or 208 ♀ fed with the normal diet during the earlier part of the experiment, which is in agreement with the results of Schafer's work (1920) on thyroid feedings with young rats. He found that thyroid glands in small doses accelerate the growth of the young.

Water soluble B

Young and adult rats could not develop normally when fed exclusively with an artificial food mixture containing all the dietary essentials in the right amount, but deficient in vitamin B (Sherman and Smith, 1922). The basal ration used in this study contained all the necessary food elements in adequate amounts for the normal development of rats, except water soluble B.

Reviewing the results obtained from the animals fed exclusively with the basal ration, it is found that both animals were able to grow but at a very slow rate for a short period and then they decreased in weight. The amount of feed eaten by each animal varied from 5 to 7 grams daily. After a lapse of time the animals began to increase again in weight; this was usually when a not very highly polished rice was used in the basal ration.

Seaweed S_1 or S_2 in amounts equivalent to 5 per cent of the basal ration enabled the animals to maintain their body weights. This may indicate the presence, in a limited amount, of vitamin B in seaweed. When

the proportion of seaweed in the basal ration was increased to 10 per cent, the rats were able to grow at about the same rate as the animals receiving 5 per cent rice bran water extract in the basal ration. The growth of the animals on a ration containing 15 per cent seaweed was about the same as the animals on a ration with 10 per cent seaweed in the basal ration.

The animals fed on rations containing 10 per cent and 15 per cent seaweed S_1 in the basal ration were able to reproduce, but the young were poorly developed and lived only for a short time. This unsatisfactory condition may have been due to the deficiency of vitamin B in the diet, for "a partial but not complete deficiency of this vitamin leads to impaired growth and a general undermining of health and vigor. This lowered vitality might have a far reaching effect in its influence on reproduction and successful rearing of the young" (Sherman and Smith, 1922). The young of the animals fed 15 per cent seaweed S_1 ration died earlier than the young of those fed 10 per cent seaweed S_1 ration. This difference may be attributed to the combined effect of the deleterious constituents of seaweed and vitamin B deficiency. The rats with a ration containing 20 per cent seaweed S_1 were poor, about the same in condition as those fed on 5 per cent seaweeds. The growth promoting effect of vitamin B in seaweed may have been overbalanced by its deleterious effects.

The food intake of the animals receiving 5 per cent and 20 per cent seaweed in the basal ration was about the same, ranging from 6 to 10 grams daily; while those receiving 10 per cent and 15 per cent were able to consume from 10 to 12.5 grams daily. During pregnancy the female consumed about 17 grams of the feed daily.

The results in the increase of body weights of rats obtained from the feeding experiments with seaweed S_2 were about the same as those obtained from seaweed S_1.

SUMMARY OF CONCLUSIONS

1. Seaweed can not support the life of guinea pigs even when supplemented with copra meal or artificial food mixture deficient in vitamin C or guinea grass to about one third of the requirements of the guinea pig of average ordinary size.

2. When seaweed formed 70 per cent of the diet, growth of rats was retarded.

3. When seaweed formed 20 per cent of the diet, the rats had normal rate of growth. Normal reproduction and successful rearing of the young were, however, not attained.

4. The rate of the decrease in weight of rats fed with seaweed is proportional to the iodine content of the latter, within a certain limit.

5. Seaweed contains little vitamin B.

ACKNOWLEDGMENT

The writer is greatly indebted to Dr. Manuel L. Roxas, Professor and Head of the Department of Agricultural Chemistry, who suggested the present investigation, for his valuable advice and help in securing materials for the experiments, and to Dr. F. O. Santos, Professor of the same Department, for his valuable suggestions and help in securing materials for the latter part of the experiment and in the preparation of this paper.

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WEIGHING LARGE FARM ANIMALS ON A PORTABLE SCALE[1]

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WITH THREE TEXT FIGURES

The paper read at the January, 1924, meeting of the Club on the subject of "A New Method of Selecting Farm Animals" depends largely upon the proper use of the data obtained from the regular weighing of animals (Gonzalez, 1924). In the discussion it was assumed that the one practicing the selection has stock scales available. Criticisms of the method voiced at that meeting were, that as few stockmen could afford to own stock scales the method could not be of wide applicability. To get around this objection, I suggested in the discussion that followed the use of a small scale, weighing two legs of an animal at a time; the sum of the front leg and hind leg weighings to constitute the entire weight of the animal. I had no data to present at that time, as the idea was inspired by the objection and I mentioned it only as a logical possibility. But I determined then to test it some time, which I did, and submit my results in this paper.

On my trip to Darwin, Australia, I saw what was virtually the method I shall describe in use in the railroad yards there (Gonzalez, 1925). As the cattle from the ranges came on the train in stock cars, they were weighed in carload units, the front wheels of the car resting on the platform of one scale and the hind wheels on the platform of another scale. The readings of the two scales added constituted the weight of the animals plus tare; subtracting the tare left the net weight of the animals in the car. There was little difference between this method and the one I proposed. In Australia they used two scales simultaneously, and any shifting in weight from one was duly recorded in the other, while in my proposed method only one scale was used and any shifting in weight from one pair of legs to the other was not necessarily accounted for. It may be stated in this connection that there is considerable shifting of weight from one end of the animal to the other, probably due to a number of causes, but chiefly to the movement of the contents of the alimentary tract.

The object of this study, which I here present, was to find out whether the method of partial weighing as proposed by me in January, 1924, may be used to determine the weight of large animals when for any reason no stock scales are available. The principal point to be determined was, whether any error which might creep in is of sufficient magnitude to render the method impractical for use.

[1] Experiment Station contribution No. 374. Paper read October 29, 1925, before the Los Baños Biological Club. Received for publication June 7, 1926.

DESCRIPTION OF SCALES

In this study a Fairbanks "Army and Navy" portable folding scale rated with a capacity of 300 kilograms was used. The scale when closed measures 27×43.5×78.5 cm. To this I had two approaches 15×60×170 cm. built up so as to stand exactly level with the platform of the scale. The approaches were slanted on one end and cleated on top so as to facilitate the ascent of the animals on the platform. (See fig. 1.) The scale, together with the two approaches when set on the ground, has a total length of 3.83 meters, and the whole weighs 116 kilograms, the scale alone weighing 60 kilograms. The scale was set on a concrete floor which afforded a very steady level base for it and for the approaches. The whole thing can easily be transported in a *carreton*, or in a *carretela*. With this contrivance practically all the large animals in the College, from calves two months old to aged bulls, have been weighed. The weights ranged from that of young animals weighing as little as 68 kilograms to the largest animal in the herd, weighing 670 kilograms. In no case did we fail to weigh any animal we

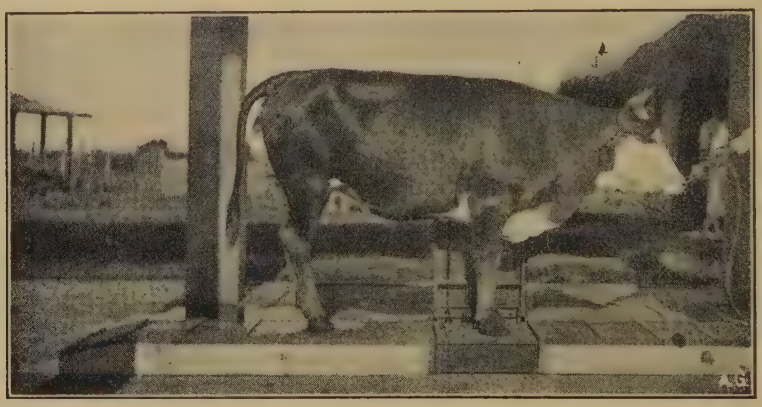

Fig. 1.—The portable scale in use, showing arrangement of approaches and front legs of animal on the scale platform in the act of weighing. (Photograph by author.)

desired to. In a few instances when the weights that came with the scale were insufficient, equivalent weights from a balance, duly standardized by actual weighing, were used. Some of the animals that were rather wild took a little time to weigh, but all went through the scales. On an average it took about five minutes to complete the weighing of an animal. Undoubtedly successive weighings would have been easier. As some animals were inclined to step off the platform, a temporary bamboo railing was erected to prevent this. This railing facilitated the weighing considerably (see Fig. 2).

PROCEDURE

The animals were brought to the scale one by one and made to step, front feet first, on the platform of the scale. No particular care was necessary as to the placement of the legs, so long as the feet rested completely on the platform and the animal assumed an easy position. Three successive readings were made in this position, then the animal was walked ahead

so that the hind feet rested on the platform, and three more readings were made. The readings were added together and the sum, divided by three, gave a number constituting the reading for the portable scale. Immediately after weighing on the portable scale the animal was led to a regular stock scale, "Old Reliable", and its weight taken to check against the portable scale weight. The beam of the portable scale was graduated into 0.2 kilogram and that of the stock scale into 2 pound units. The partial weighings were done by the writer, while the stock scale weighings were made by foreman Valentin Barili.

Fig. 2.—With animals inclined to be restless a railing such as this facilitates weighing considerably. (Photograph by author.)

CALIBRATION OF THE TWO SCALES

In order that the relative accuracy of the two scales may be gauged, persons were weighed on both with results as follows:

TABLE 1

Comparative weight of human controls

SUBJECT	"OLD RELIABLE" STOCK SCALE		FAIRBANKS' "ARMY AND NAVY" PORTABLE SCALE	DIFFERENCE	RATE OF DIFFERENCE
	lb.	*kgm.*	*kgm.*	*kgm.*	*per cent*
B. M. G.	176	79.8	80.2	0.4	.50
F. M. F.	139	63.0	63.2	0.2	.32
S. P.	126	57.2	59.0	1.8	3.15
A. M.	116	52.6	53.4	.8	1.52
J. P. E.	115	52.2	53.3	1.1	2.11
V. B.	104	47.2	49.3	2.1	4.45
A. T.	97	44.0	44.6	0.6	1.36
Total	873.0	396.0	403.0	7.0	13.41
Average	124.7	56.6	57.6	1.0	1.92 ± .347

As the stock scale reads in pounds the reading was reduced to kilograms with the aid of a conversion table accurate to five decimal places (Gonzalez and Taleon, College of Agriculture Circular No. 6).

The results show that there is an average difference of one kilogram to a subject weighed in favor of the portable scale. Based on an average weight of 56.6 kilograms, the discrepancy between the two scales amounts to 1.92 per cent.

As the "Old Reliable" stock scale was used in every case to check the reading from the portable scale, any discrepancy amounting to about 1.92 per cent may be attributed to an intrinsic difference in the accuracy of the two scales or to error by the one doing the weighing, rather than to the method of weighing that is being tested.

It may be argued in this connection that the stock scale, being made purposely to weigh heavy masses, can not weigh, accurately, light masses. This does not appear tenable, however, as inspection of the figures shows that the greater divergences are as likely to occur with the lighter masses as with the heavier. The figures in tables 2 and 3 further substantiate this statement. In table 2 the animals are listed in descending order of weight, but it can be seen readily that there is neither order in the column of actual weight differences nor in the expression of these in percentage in the last column, indicating that variations and their magnitude occur at random.

RESULTS OF WEIGHING LARGE ANIMALS

All in all, ninety-five animals were weighed to test the accuracy of this method of weighing on a portable scale. As the figures are too numerous for presentation in detail, only those of the largest group are given itemized, and of the other groups a summary is presented.

Table 2 shows that the rate of difference with work bullocks weighed on the two scales is 1.28 $\pm$.145 per cent. Comparing this with the difference in weight of human subjects we get 1.92 $\pm$.347 per cent—1.28 $\pm$.145 per cent = 0.64 $\pm$.376 per cent.

The signs of the differences in table 2 have been purposely omitted in order that the discrepancy may not be minimized, but rather exaggerated. In weighing the work bullocks as well as the other animals, about two thirds of the time the difference was in favor of the portable scale, and one-third in favor of the stock scale, indicating that the portable scale was inclined

to weigh heavier. This agrees in general with the results obtained with the control subjects.

Assuming 1.92 per cent as the normal difference between any two readings on the two scales, a true test of accuracy of the partial weighing method may be made by comparing the difference between the weight readings of any animal by both methods with the above standard and applying the probable error test. In the case of the work bullocks the probable error of the difference is less than twice the difference and is therefore not significant.

TABLE 2

Comparative weight of work bullocks

NAME	SEX	BREED	PORTABLE SCALE	STOCK SCALE		DIFFERENCE	RATE OF DIFFERENCE
			kgm.	*lb.*	*kgm.*	*kgm.*	*per cent*
1. Hari	M	Native	459.6	988	448.1	11.5	2.57
2. Orlando	M	Native	452.0	992	450.1	1.9	.42
3. Martin	M	Native	442.1	986	447.2	5.1	1.14
4. Kaiser	M	Native	425.9	976	442.7	16.8	3.79
5. Bugtong	M	Native	421.7	930	421.8	.1	.02
6. Abuhin	M	Native	418.1	918	416.4	1.7	.41
7. José	M	Native	409.2	894	405.5	3.7	.91
8. Lorenzo	M	Native	407.8	890	403.7	4.1	1.02
9. Felipe	M	Native	406.0	895	406.0	.0	.00
10. Julio	M	Indo-Chinese	397.0	866	392.8	4.2	1.07
11. Francisc	M	Native	392.2	865	392.4	.2	.05
12. Pedro	M	Native	390.5	860	390.1	.4	.10
13. Amado	M	Indo-Chinese	387.7	842	381.9	5.8	1.52
14. Datu	M	Native	379.8	863	391.4	11.6	2.96
15. Juan	M	Native	377.5	826	374.7	2.8	.75
16. Castanyo	M	Native	373.9	800	362.9	11.0	3.03
17. Manuel	M	Native	372.9	820	371.9	1.0	.27
18. Ruperto	M	Indo-Chinese	366.0	786	356.5	9.5	2.66
19. Laureano	M	Indo-Chinese	365.2	789	357.9	7.3	2.04
20. Dupong	M	Native	364.7	818	371.0	6.3	1.70
21. Dagim	M	Native	363.6	796	361.1	2.5	.69
22. Munti	M	Native	363.4	810	367.4	4.0	1.09
23. Ulandes	M	Native	358.3	782	354.7	3.6	1.01
24. Pungol	M	Native	356.1	761	345.2	10.9	3.16
25. Tungtuñgin	M	Nellore-Native	348.7	762	345.6	3.1	.90
26. Maximo	M	Native	335.4	739	335.2	0.2	.06
Totals			10135.3		10094.2	129.30	33.34
Averages			389.8		388.2	4.97	1.28 ±.145

TABLE 3

Comparative weights of different kinds of animals

KIND OF SUBJECT	NUMBER	AVERAGE WEIGHT ON STOCK SCALE	MEAN RATE OF DIFFERENCE BETWEEN WEIGHINGS ON STOCK AND PORTABLE SCALES OF SAME SUBJECTS	MEAN DIFFERENCE BETWEEN WHOLE (HUMAN) AND PARTIAL (ANIMAL) WEIGHING METHODS
		kgm.	*per cent*	*per cent*
Human	7	56.6	1.92 ± .347	——
Horses	5	218.6	1.02 ± .026	.90 ± .348
Work bullocks	26	388.2	1.28 ± .145	.64 ± .376
Native cows	6	270.4	1.23 ± .625	.69 ± .716
Indian cattle	9	337.7	1.11 ± .973	.81 ± 1.033
Hereford cattle	4	373.5	0.88 ± .341	1.04 ± .487
Grade cattle	19	234.0	1.32 ± .732	.60 ± .810
Carabaos	17	434.3	1.55 ± .519	.37 ± .624
Indian buffaloes	9	441.5	1.10 ± .534	.82 ± .637

In table 3 is presented a summary of the results obtained with different kinds and groups of animals. The figures are uniform in showing that there was less divergence between the stock scale and the portable scale weighings when the partial weighing method is used than in the control where human beings were weighed at one weighing. At first glance one may be inclined to the conclusion that the partial weighing method is even more accurate than the usual way. This conclusion is hardly warranted, however. It is only fair to assume that the whole weight method is more direct and bound to be more accurate. There is a possible justification for the apparent greater accuracy in this case, however, in the fact that three weighings were made with the portable scale while only one was made with the stock scale. The divergence in the readings may be attributed to three possible sources of error: (1) to the imperfection of the weighing machines; (2) the personal factor in the individuals doing the weighing; and (3) to the animal losing weight while traveling from one scale to another owing to the passing of liquid or solid excreta, as the two scales were set about 50 meters apart. No particular attention was paid to this latter point, and while it may have occurred in a few cases, it surely was not general. It would be expected that there would be greater divergence between the animal weighings than in the case of the control if this were general, and such is not the case.

Examination of the figures shows that in no case is the average difference between the partial weighing of a group of animals and the control greater

than three times the probable error of this difference. In some instances as in the carabaos, grade cattle, Indian cattle, and native cows the probable error of the difference is even greater than the difference. None of these animals can mechanically shift its weight on to three legs, as the horse can, and hence one would hardly expect from them as great variation in their weight readings as in the horse. The almost significant figure of the horse is to be expected as it is well known that some horses can and do stand on three legs many times, resting alternately one of the hind legs. This behavior is likely to cause the center of gravity to shift forward and backward and thus cause greater or less weight to be carried alternately on the front or hind legs. The center of gravity of the horse is also higher as compared with the base of support, than in any of the other animals tested, and is consequently more likely to oscillate forward or backward, thus tending to introduce greater variation and inaccuracy in the readings.

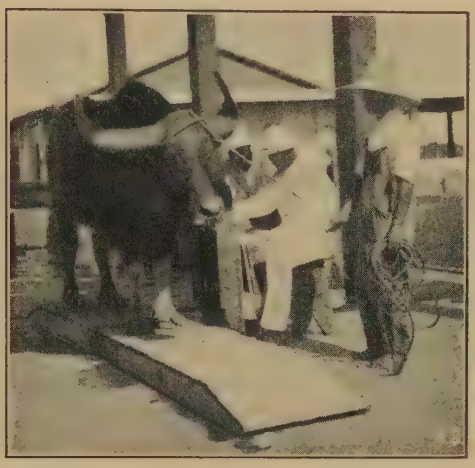

Fig. 3.—The heaviest animal in the herd, a carabao weighing 670 kilograms, on the portable scale. (Photograph by Dorothy C. Hall.)

It may be mentioned in this connection that the method was tried with men, weighing one leg at a time. The results were very inaccurate, for reasons similar to those mentioned for the horse, only more exaggerated.

ACCURACY OF SINGLE WEIGHINGS

The chief objection we find in the partial weighing method, taking three readings at a time, is the slowness of the process. If a way could be found to hasten the weighing of animals without materially affecting accuracy, it would be decidedly advantageous. A study was made of the rate of variation of the maximun and minimum readings for each animal. To obtain the figures the first reading of the forelegs was added to the first reading of the hindlegs, second with second, and third with third. The largest sum thus obtained was called the maximum reading for that animal and the smallest sum the minimum, and the average of the three as the mean weight of the animal.

Table 4 gives a summary of the figures thus obtained:

TABLE 4

Variation in weight of different animals

SUBJECT	NUMBER	MEAN DIFFERENCE BETWEEN MAXIMUM AND MINIMUM READINGS	RANGE OF INDIVIDUAL DIFFERENCES TO INDIVIDUAL AVERAGE WEIGHT	MEAN WEIGHT	RATIO OF MEAN DIFFERENCE TO MEAN WEIGHT
		kgm.	*per cent*	*kgm.*	*per cent*
Horses	5	3.90	0.6–2.4	220.80	1.77
Draft cattle	26	5.15	0.3–3.3	389.82	1.32
Native cows	6	2.45	0.2–1.5	271.08	0.90
Indian cattle	9	4.20	0.3–3.5	340.09	1.23
Hereford cattle	4	3.95	0.5–2.2	376.72	1.05
Grade cattle	19	3.27	0.2–3 6	233.25	1.40
Carabaos	17	4.11	0.1–1.8	436.76	0.94
Indian buffaloes	9	4.73	0.5–2.3	445.82	1.06
Total	95			Average	1.21

It may be seen that the highest variation recorded for any one individual amounts to 3.6 per cent, and the general average for all the animals is 1.21 per cent. Considering that Philippine work bullocks may consume in one meal feed equal to 3.55 per cent of their live weight (Lago, 1919) and that according to Van Slyke (Henry and Morrison, 1916) cattle produce as much manure as 7.4 per cent of their weight, in one day, thus affecting their normal weight to that extent, one can readily see that a variation of 1.2 per cent in the weight of an animal is not large.

It appears therefore that one weighing for each half of the animal is sufficient for practical purposes.

SUMMARY

1. The present study deals with the use of a portable scale in weighing large farm animals, such as cattle, carabaos, and horses. This method of weighing was first suggested in connection with a proposed method of selection on the basis of development as evidenced by periodic weighings of a growing animal. It has been demonstrated that any variation between the usual method of direct weighing and the proposed partial method of weighing one half of the animal at a time, making three successive readings at a time, is well within the realm of probability. Therefore, the method is fairly accurate.

2. For various reasons, as limited resources, infrequent need of a stock scale, disinclination to invest in this particular equipment, stock owners, farm schools, and institutions interested in animals, frequently possess only a portable scale. For these individuals and institutions the partial method of weighing will find its greatest usefulness.

The method will also find practical application in field investigations requiring the weighing of animals.

3. Its chief disadvantage, the comparatively longer time it takes to weigh an animal, can be overcome partially by making only one weighing of each half of the animal instead of three. It has been demonstrated that the weight obtained thus is sufficiently accurate for most purposes.

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A STUDY OF THE PHILIPPINE PONY AS FOUND IN LIPA, BATANGAS[1]

URBANO A. MOJARES

The objects of the work reported in this paper were: (*a*) To determine the good points of the Philippine pony as found in Lipa, Batangas; (*b*) To determine its bad points; and (*c*) To formulate suggestions towards its improvement.

This work was carried out in Lipa, Batangas Province, generally considered as the region where the best Philippine ponies are produced. The investigation covered a period of about one and a half years, from June, 1922, to January, 1924.

MATERIALS

During the course of this study the author was able to study 282 horses, typical representatives of the Philippine pony as found in Lipa. A steel sliding rule graduated in inches was used in measuring the height. A score card was used as a general guide in the systematic study of the horse.

PROCEDURE

Horses were selected at random. The general condition of the horse was observed as well as the sex, temperament, conformation, and the name of the owner. These data were recorded to avoid duplication of observations on the same horse.

Determination of height

The horse was made to stand on level ground and to assume a natural position while the height was measured.

Determination of age

The age of the horses studied was determined from their certificates of registration. In a few cases where these certificates were not available, the writer used the teeth as indexes of the age of the animal. The mouth of the animal was opened wide by holding the tongue with the right hand and pulling with the left hand the lower lip downward to make the teeth visible.

[1] Thesis presented for graduation, 1924, with the degree of Bachelor of Agriculture, from the College of Agriculture No. 228; Experiment Station contribution No. 375. Prepared in the Department of Animal Husbandry under the direction of Dr. Valente E. Villegas.

For this purpose the schedule used by Lizaso[2] was adopted. The schedule is as follows:

At birth	None
At one year old	All temporary incisors out
At two years old	All temporary incisors in full wear
At three years old	Permanent pincher incisors out
At four years old	Permanent intermediate incisors out
At five years old	Permanent corner incisors out
At six years old	Cup of lower pinchers worn out. Canines appear
At seven years old	Cups of lower intermediates worn out
At eight years old	Cups of lower corners worn out
At nine years old	Transition period
At ten years old	Cups of the upper pinchers worn out
At eleven years old	Cups of the upper intermediates worn out
At twelve years old	Cups of the upper corners worn out
At thirteen years old and later	Determination of the age is by the angle of the teeth

Determination of color

The color of the horses studied was determined by general inspection.

The use of the score card

A score card or an outline of the points to be observed in detail was used. This served as a guide in the systematic observation of the horse so as to detect all the good and bad points. The different parts of the body were thoroughly examined and palpated to discover the quality of the skin, hair, bones, and tendons. This method was used particularly in examining the bones of the canons and texture of the skin.

In the course of the investigation, verbal inquiries were made of the owners of the different horses studied at various times so as to get a general idea of the environment of the animal. Special consideration was given to the kind and amount of feeds given; the nature of the work done; and the care and management to which could be attributed the condition, blemishes, defects, and desirable qualities of the animal.

DISCUSSION OF RESULTS

Observations were made on 282 horses of which 207 were males and 75 were females. These horses are typical representatives of the Philippine pony as found in Lipa. They were taken from the población, and from the different barrios of this municipality. It may be noted that there is a preponderance of males over females. Only one animal was found castrated.

Height

There was quite a degree of variation in the height of the ponies studied. The greatest frequency falls at 50 inches. Table 1 shows that the most

[2] Lizaso, Juan. Observation on the Philippine horse. THE PHILIPPINE AGRICULTURIST **10**: 135–144. 1921.

common height is from 49 inches to 51 inches. The average height of the ponies studied was 50.51 inches (128.3 cm.). This compares favorably with the average height of Los Baños, Calamba, and Bay horses, which was only 48.7 inches as reported by Lizaso or a difference of 1.81 inches in favor of the Lipa pony.

TABLE 1

Showing frequency distribution of height

CLASS VALUE	FREQUENCY	FREQUENCY VALUE
inches		
46.5	1	46.50
47.0	10	470.00
47.5	2	95.00
48.0	16	768.00
48.5	15	727.50
49.0	23	1127.00
49.5	25	1237.50
50.0	56	2800.00
50.5	37	1868.50
51.0	22	1122.00
51.5	15	772.50
52.0	13	676.00
52.5	11	577.50
53.0	7	371.00
53.5	4	214.00
54.0	7	378.00
54.5	6	327.00
55.0	3	165.00
55.5	5	277.50
56.0	4	224.00
Total	282	14244.00
Average		50.51

Age

Table 2 shows the frequency distribution of age. It will be seen in this table that the horses examined ranged in age from 2 to 17 years. However, the most common age was from 3 to 7 years. The greatest frequency falls on 4 years. At the age of one and a half to two years the horses are trained to pull a *carromata* and used occasionally. At the age of 4 to 5 years the horse is at its prime and apparently at the peak of its market value. The owners generally start using their horses for driving when about two years old and dispose of them when they are 4 to 5 years old, so that besides getting a good income from them the animal appreciates in value in the meantime.

The average age of the horses studied was 6.2 years as compared with 6.96 years, the average age of Calamba, Los Baños, and Bay horses as found by Lizaso.

TABLE 2

Showing frequency distribution of age

CLASS VALUE	FREQUENCY	FREQUENCY VALUE
years		
2	17	34.00
3	36	108.00
4	56	224.00
5	40	200.00
6	31	186.00
7	27	189.00
8	12	96.00
9	21	189.00
10	9	90.00
11	11	121.00
12	6	72.00
13	4	52.00
14	3	42.00
15	4	60.00
16	2	32.00
17	3	51.00
Total	282	1746.00
Average		6.19 *yrs.*

Color

Table 3 shows the frequency distribution of color. Bay was the commonest color observed, as was found by Lizaso. Brown, gray, roan, and buckskin ranked next in the order named. This varies from Lizaso who found black, roan, and white the colors that ranked second. Gray is considered to be the most beautiful color.

TABLE 3

Showing frequency distribution of color

COLOR	FREQUENCY
Bay	79
Brown	49
Gray	37
Roan	27
Buckskin	25
Chestnut	15
Dark bay	11
Mouse color	11
Black	10
Light black	6
White	6
Albino	6
Total	282

Conformation of the horses in Lipa

It was found that the horses in Lipa have a fairly good conformation. They have a nice general appearance; they are alert, and of strong constitution. They are very hardy. The Philippine pony can perhaps be favorably compared with any breed of horses of its size as regards strength and power of endurance. The Philippine ponies are refined, as shown by the fine texture and quality of the skin and hair, and smoothness and refinement of the bones.

A more detailed description of the parts follows:

The head. The head is generally refined and well carried. The face line is straight and the features of the head sharply defined. The head is generally of coffin shape, large and broad at the forehead, and small and tapering towards the nose and mouth. Too large a head in proportion to the body of the animal was observed in 20 horses. Overshot mouth was observed in 46 horses. Undershot, the opposite condition, was observed in 10 horses. The eyes as a rule are bright and full. The ears are of medium size and alert.

The neck. It was observed that the most common blemish of the neck was collar sore. This condition was caused by the irritation of the ill-fitted collars inflicting injury on the neck. In driving horses, the neck is generally strong and muscular. The windpipe is large, indicating a good respiratory system. Horses that are distinctly of the race type have necks that are thin and long.

Fore quarter. The fore quarters are remarkably strong, well-muscled, and smooth. The shoulders are oblique and strong. The chest is deep, broad, and with a large heart-girth. The vigor of the Philippine pony may be attributed to a large extent to the excellent make up of the chest and the fore quarters as a whole.

Scars and fresh wounds were observed on the shoulder. They are also caused by poorly fitted collars.

The forelegs are generally well placed, sound and strong. Base wide position, however, was observed in 26 horses. Base narrow position was found in 11 horses. Base narrow and toe wide conformation was observed in 17 ponies. The knees of the horses studied are as a general rule straight and wide. Calf-kneed conformation was observed in 14 horses.

Scars were observed on the knees of 26 horses. This condition is due to stumbling. Weakness of the knee is of course a predisposing factor to stumbling.

Interfering was observed in 15 horses as indicated by scars or wounds on the fetlock.

The body. The horses studied generally have good bodies. The back is generally short and strong. The ribs are well sprung. Scars were found on the backs of 6 horses. This condition was brought about by poor-fitting saddles.

Hind quarters. The hind quarters are generally deficient in muscling. The hips are generally narrow. A serious defect observed was the drooping croup found in 46 horses.

Cow-hocked conformation was found to be present in 54 horses and as a consequence of this defect interfering was common.

Forging is also common particularly in horses used in driving. Paddling was found, but not common. Bone spavin was found in 10 horses. Wind-puffs was also observed in quite a number of horses. The pasterns are generally strong.

General

The author was able to get a general idea of the care, feeding, and management of the horses in Lipa through inquiries of the owners of the horses studied.

It was found that the horses were not properly fed and managed. Poor feeding was found to be the principal cause of the poor condition of many of the horses studied. The quality of the feed given did not receive any consideration as a rule. Work horses were not given enough concentrates to supply the necessary nutrients in order to keep the animal in good physical condition. Only rice bran was given as a supplement to the roughage allowance which consisted mainly of corn stalks, barit (*Leersia hexandra*), peanuts, and pasture grasses of various kinds. Even rice bran was not often given in sufficient quantities, and in some cases it was found that no rice bran nor any concentrate at all was given to working horses. In a few cases, however, corn, palay, mungo (*Phaseolus radiatus* Linn.) and tapilan (*Phaseolus calcaratus* Roxb.) were fed to horses.

Many horses were not properly managed. Most of the light draft horses studied were over-worked, thus were greatly run down in condition. It was not rare to see young horses stunted in their growth due to over-work.

As shown in the above discussion the ponies found in Lipa are much better in size and conformation than those found by Lizazo in Los Baños, Calamba, and Bay. It is worthy of mention that this marked improvement of the Philippine pony in Lipa is, to a large extent, the effect of the breeding work carried out by the Bureau of Agriculture in this town. This statement is supported by the fact that the most beautiful horses, constituting a large part of the number of horses studied, have been traced, through information from the owners, as progeny of the stallions which were at different times at the Breeding Station in Lipa.

SUMMARY

1. This investigation involved the examination of 282 horses.

2. The horses studied varied from 46½ to 56 inches in height. The greatest frequency falls at 50 inches (127 cm.). The average height was 50.51 inches (128.3 cm.).

3. The average age found was 6.2 years. The greatest frequency falls at four years.

4. The most frequent color was bay, brown, gray, and roan in the order named.

5. The head is generally refined, clean cut, and lean.

6. The neck is as a rule muscular and strong.

7. The fore quarters are generally well muscled and strong, and the forelegs are generally sound and of good conformation.

8. The back is generally strong.

9. The hind quarters lack muscling. The croup is droopy and short. Cow-hocked conformation is a common defect.

10. Wind puffs and bone spavins were observed in a few horses.

11. Castration was not practiced.

12. In actual use there was a preponderance of males over females.

13. Horses in Lipa are not properly fed and managed.

CONCLUSIONS

From the observations made the following conclusions are given

1. Good points of the Philippine pony as found in Lipa:
   a. Good general appearance.
   b. Sound conformation, vigorous constitution, stylish, and alert.
   c. Power to endure adversities of environment.
   d. Capacious body with good underline and strong back.
   e. Deep chest, large heart girth, and a good respiratory system.
   f. Refinement of the animals as shown by the quality of the skin, hair, and bones.
   g. Better size than ponies of Los Baños, Calamba, and Bay
2. The common defects of the ponies in Lipa are:
   a. Lack of muscling in the hind quarters.
   b. Drooping croup.
   c. Comparatively large head in proportion to the body.
   d. Cow-hocked conformation.
   e. Calf-kneed conformation.
   f. Base narrow standing position.
   g. Splay footed or toe wide conformation.
   h. Poor condition of the animal.
   i. Vicious temperament.

RECOMMENDATIONS

1. Proper selection of breeding animals should be exercised. The breeding work started and later dropped by the Bureau of Agriculture should be established again in Lipa.

2. Horses should be properly managed and better fed.

3. They should be properly trained in order that they may attain their highest efficiency.

4. The animals should not be over-worked. Young horses should be used only occasionally.

5. Harness and saddles should be properly fitted to the animal to avoid irritation and suffering.

6. Proper shoeing should be practiced to avoid interfering which may be the result of improper shoeing, and to correct faulty conformations which predispose the animal to interfering.

7. Animals not intended for breeding should be castrated. This is one way of producing a good working animal which is easily managed and easily maintained in proper working condition. By castration, animals of undesirable qualities are prevented from breeding and their defects and faulty conformation kept from being transmitted.

8. Bone spavin and other bone afflictions, wind puffs, etc., should be properly treated.

A CASE OF TERATOLOGICAL TWINING IN BANANA[1]

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Fig. 2.—Longitudinal section showing the two distinct stalks (*a* and *b*).

Fig. 1.—A banana twin.

In the Philippines the most common case of banana "twining" is where two or more fruits within the "hand" are connected by the fruit skin. The case here reported is rather peculiar in that there are two fruit bunches within one banana stem (see fig. 1). The material is of a Bongolan variety. It was obtained from the agricultural exhibit on Garden Day at Los Baños, Laguna, P. I., February 21, 1926. The two fruit bunches show no sign of deviation from the average size or normal number of "hands" of the ordinary form. Each fruit bunch compares favorably with that of the average banana. At a glance one is likely to think that one of the fruit bunches branched from the other. Longitudinal section of the stem (see fig. 2) shows that the two fruit bunches are really two distinct bunches which are enclosed in the cylindrical stem of the plant. The two flower stalks (central fleshy portions) are placed side by side, and may be traced in this fashion downward to the corm (rootstock). It is probable that the appearance of two distinct vegetative buds which are somewhat fused in the parent corm, and developed into two separate stalks and then enveloped by the leaf sheaths of the stem, gives rise to this case of teratological twining.

[1] Experiment Station contribution No. 376. Received for publication May 14, 1926.

NOTE ON BAKER'S STUDY ON "SOME LOPHOPIDÆ"[1][2]

A total of fifteen genera and twenty-nine species are dealt with. These are included in two subfamilies as follows:

Lophopinæ

11 genera, one of which is new.

24 species, 6 new.

Acarninæ

4 genera, 1 new.

5 species, 4 new.

Some of the species, especially those of the genus Lophops, are of economic importance. The sources of the material used were Java, the Moluccas, Papua, Queensland, India, and the Philippines.

A critical review of previous systematic work on the subject comprises the main introductory part. Dichotomic keys for the separation of subfamilies, genera, and species are furnished, thus enhancing the usefulness of the paper, even in the hands of a non-specialist.

As a minor criticism, it may be pointed out that a more comprehensive characterization of the family would have given the general reader a more concrete idea of the group. The figures were carefully and skilfully prepared. However, apparently through no fault of the author, the white lines and shades on a black background in the plates produce a negative visual, or "blackboard," effect, which reverses the perspective. These points, however, do not detract from the value of the paper, which is so far the first attempt on the part of any investigator to establish this little known, and hitherto poorly defined, homopterous family on the more logical basis of diagnostic structural characters.

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Of the Department of Entomology

[1] Baker, Charles Fuller. 1925. Some Lophopidæ (Fulgoroidea) of the Indo-Malayan and Papuan Regions. Treubia 6: 271–296. *Pl. 2–8.*

[2] General contribution or in the College of Agriculture No. 173.

NOTE: ADDRESS BY DEAN BAKER AT LOS BAÑOS MILITARY CEMETERY ON DECORATION DAY, MAY 31, 1926.

We speak to the spirits of you whose ashes rest here:

You were soldiers! Before and since Thermopylæ and down to Verdun, your comrades, at their best, have taught the world the highest, purest, and most complete patriotism. So very far as we are yet from the millenium, the profession of soldiery is vital to the life of the world. To it primarily we owe the safety of our country from aggression, the sanctity of our homes, the blessings of peace, the great common privilege of going about our business without fear of molestation. *You* joined this profession voluntarily, and in so doing you voluntarily offered your time, your strength, and your very *life* whenever need be, to this public service, and you did this on pay *in no wise commensurate* with what you offered. A vast army of your comrades who never had had more than a bare living out of their profession yet gave for it the supreme sacrifice—the greatest service that any man may render to fellowmen.

Today, standing here with you, we are led to wonder what we, in the many other lines of human endeavor, are doing, that may in any wise be compared with this. We scramble for preferment and for money! We worry lest we shall not receive the fullest compensation for everything we do! We are loath to give any public service for which we are not fully paid! We are entirely absorbed in our own selfish little private ends! *God forgive us!*

Well for us, and well for this country, that we meet with you and your comrades here once each year to think of these things—nobler things—to vision a patriotism that recognizes no limit of self-sacrifice.

We will not forget you! We honor you!
We salute you!
Vale!

EXCHANGE NOTES

For the utilization of tobacco waste in the preparation of a suitable spray, it is essential that the final spray solution should contain from .05 to .1 per cent of nicotine for the effective control of aphids.

It is popularly supposed by farmers that to obtain the nicotine in solution, the tobacco should be boiled for about an hour. Rather extensive experiments were carried out at the Elsenburg which prove that it is possible to extract the nicotine as efficiently by means of cold water as by hot or boiling water. The amount of nicotine lost by boiling the tobacco in water for half-an-hour amounted to about 3 per cent of the total nicotine extracted, which can be considered as negligible.

For the purpose of preparing the tobacco spray it is not advisable to use the stems alone, for their nicotine-content is too low. The most suitable material to use is the waste tobacco leaves.

A spray mixture was prepared by treating 10-lb. of waste tobacco leaves with 10 gallons of water. In one case the water was brought to boiling point and the tobacco was then added to it and boiled for half an hour; the liquid was then poured off, the leaves were squeezed to remove adhering water, and the final solution was made up to 10 gallons. In comparison, the same amounts of tobacco and cold water were used, but were left to stand overnight, *i. e.*, for 12 hours. The solution was then poured off and the leaves pressed, and again the volume was made up to 10 gallons.

—*Journal of the Department of Agriculture* (Union of South Africa)

Last spring, when little Julia Irish, thirteen years old, started work as a member of the Atlanta boys' and girls' corn club in Logan county, Illinois, she made the statement that the girls could beat the boys. She proved it recently when she was crowned junior corn king of the state at the sixth annual Illinois Seed Grain show. Julia won the right to the title when she took the grand sweepstakes prize in the junior classes on her ten-ear sample of yellow, utility type corn. . . .

—*Successful Farming* (Iowa)

Production of a new kind of sugar approximately one and three-fourth times sweeter than ordinary sugar and extracted from a wild plant which grows abundantly in the United States was explained by Dr. George K. Burgess, director of the Bureau of Standards. . . .

The plant is the Jerusalem Artichoke, a hardy tuber which grows without cultivation in every section of the country.

Dr. Burgess held that this plant has twice as much sugar content as sugar beet and that it is practically certain that it could be developed to increase this quality.

—*Sugar News* (Philippines)

A pageant and apple show to celebrate the sesquicentennial birthday of Johnnie Appleseed is being planned for 1926 by the Chicago Historical Society. Johnnie Appleseed became famous when he came West in the early nineteenth century and devoted his life to distributing apple seeds and starting nurseries to propagate fruits. The Chicago public schools will probably take part in the celebration.

—*The Prairie Farmer* (Illinois)

No matter what success we achieve as farmers or moneymakers, our lives will nevertheless be largely failures if we do not train our boys to be industrious, thrifty, honorable citizens.

And if our sons are to lead worth while lives as men, they must have the right sort of training while they are yet boys. There must be a very genuine partnership of sympathy, and just as far as practicable a business partnership, between father and son. The farmer who accumulates land and stock and farming equipment, expecting to leave it to his sons, but making no effort to train them in business habits and farm management so they can conduct the farm properly after they inherit it, commits a crime against their future welfare. . . .

There is hardly any better way to develop manliness or business habits in a boy than to give him a savings account in some bank. . . . And the best of all ways to get a boy successfully started with a bank account is to put the youngster in club work or give him a project in vocational agriculture as a high school student. . . . Give him a pig or a flock of chickens, or a calf or an acre of corn, and then let him have the proceeds (or at least the net proceeds above costs of bought feed and fertilizers) for his very own.

—*The Progressive Farmer* (Alabama)

Yam Fritters. Pare and boil half a pound of yam until soft, beat lightly with a fork; beat the yolks of four and the white of three eggs, and two spoonsful of cream, two tablespoonsful of wine, one dessert-spoonful of lemon juice and half a teaspoonful of grated nutmeg; beat all altogether until extremely light, put plenty of lard into a frying pan and drop a tablespoonful of the batter at a time into it, and fry the fritters to a nice brown. Serve with wine sauce (served separately), or only sprinkle powdered sugar over them.

COLLEGE AND ALUMNI NOTES

The following is quoted from *Breeder's Gazette*, April 22, 1926:

From the January, 1926, number of *The Philippine Agriculturist*, a monthly published by the College of Agriculture of the University of the Philippines, Los Baños, Laguna, I quote the following, written by Charles Fuller Baker, dean of the college: *The world of science knows no lines of race, nationality, wealth, caste or cut of garments. It is the purest democracy on earth.*" That is a clear and noble statement. The world's population can never be excessive in the world of science. All genuine scientists not only are democratic in the best sense but tolerant and human. Science blows no horns, has no creeds and wears no tags. It represents the free spirit of man in quest of elusive, hidden truth in a universe of law and order. It is the spirit of Plato in the realm of concrete facts that affect our daily lives.

Dr. G. Wilbrink, plant pathologist to the Experiment Station of the Sugar Industry of Java, was a visitor of the College of Agriculture on June 8. Miss Wilbrink has been Acting Director of the Cheribon Sub-station of the Java Sugar Industry.

From a June issue of *Philippines Tribune:*

In line with this new policy, the secretary of justice also assigned Assistant Superindent Macasaet of the Iwahig Penal Colony as acting superintendent of San Ramón. Mr. Macasaet is an agricultural expert and the extensive development of agricultural activities among the convicts in Iwahig has been due to his work. He will try to start an agricultural program in San Ramón planned to make the colony self-supporting like Iwahig, according to Secretary Torres.

Mr. Macasaet was graduated from the College of Agriculture in 1918.

Miss Marcia Whipple has been appointed to a position in the English Department. Miss Whipple is a graduate from the University of Wisconsin and has done graduate work at Wisconsin and George Washington Universities. For the past four years she has been a member of the faculty of the State Teachers' College at Whitewater, Wisconsin.

Dr. B. M. Gonzalez was appointed by the Governor-General to be one of the representatives of the Philippine Islands at the Third Pan-Pacific Science Congress to be held in Tokyo, Japan, October 27 to November 9.

Quoted from *Verdad*, Tuguegarao, May 8, 1926:

Prof. Inocencio Elayda, Prof. Mariano Lopez, and Instructor Pedro David of the College of Agriculture have arrived in this municipality (Tuguegarao). They came to the Valley to conduct a short investigation on the agricultural possibilities in this region. They have already been in the neighboring municipalities of this province. Today they have left for the towns of Itawes country of the jurisdiction of Cagayan. They are accompanied by Mr. Alfonso Cagurañgan of the High School at Ilagan, Isabela, who has been in the city for the past few days. Mr. Cornelio Balangue, Extension man of the Bureau of Agriculture for this province has been accompanying the travellers on their trips through several towns. We extend to the party our welcome, wishing that the investigation which is the object of their trip may be fruitful of results for the interest of the Cagayan Valley.

Messrs. Cagurangan and Balangue were graduates from College of Agriculture in 1916.

Miss Margaret Wilson of the English Department spent part of her vacation at Canton Christian College. While there she addressed the girls of the college on the student and club life of the young women of the Philippines.

Mr. O'Leary of the English Department taught in the summer school of College of Liberal Arts.

"Mammoth incubators in the Philippines" is the title of an interesting article by Dr. F. M. Fronda appearing in the December–January, 1925–1926, issue of *Poultry Science*. It deals with the duck egg hatcheries of Pateros in Rizal Province. The editor of the journal comments as follows on the article:

It is easy for most of us to become so absorbed in our day to day work as to forget that the rest of the world is moving on or that some one somewhere may already have done the thing we are trying to do. To a certain extent this is, of course, desirable, but it is well to pause occasionally to see what is going on in other places.

In this connection the article on "Mammoth Incubators in the Philippines," by F. M. Fronda, which appears in this issue should be of more than passing interest. Dr. Fronda has endeavored to give a detailed description of methods in use by commercial hatchery operators, together with illustrations and descriptions of the incubators and their management.

It is an excellent example of the development of the "art" of poultry husbandry in a situation where, as the author points out, the "science" of the subject is quite largely lacking.

The following is quoted from *Journal of the Institute of Metals*, London:

Preparation of Scientific and Technical Papers. By Sam F. Trelease and Emma Sarepta Yule. Cr. 8vo. Pp. 113. 1925. Baltimore: Williams and Wilkins Co. (Price $1.50).

Although this little book is primarily written for botanical students, others who are likely to be engaged in the preparation of scientific papers for the press will derive great benefit from its perusal. Taken in conjunction with Sir Clifford Allbutt's book (see this

J, 1914, **31**: 583) it forms a complete guide to authors in the construction and writing of a scientific paper or thesis. Whereas Allbutt's book deals chiefly with grammatical points and style the book under review is concerned with the construction of the paper from the results recorded in the laboratory notebook. The earlier pages describe an excellent method of planning out and arranging the subject-matter, so as to place before the reader in an orderly manner a clear and concise account of the work done and the conclusions derived therefrom. Then follows a detailed description of the kinds of type used in printing and the methods of indicating them in the typewritten manuscript. Further sections deal with the correction of proofs and different ways of citing the literature. Altogether the book should prove invaluable to authors, especially to advanced students preparing theses for degrees.

—*A. R. P.*

The following students who took the short course in Poultry Raising given by the Department of Animal Husbandry as a summer extension course were granted certificates: Estanislao Aquino (Zambales), Ignacio P. Belen (Bulacan), Marcelo Faulve (Rizal), Simeon Limban (Zambales), Hipólito S. Nerizon (Laguna), and Pedro C. Palafoz (Manila).

Mr. Alejo Taleón of the Department of Animal Husbandry has recently joined the rank of the benedicts. He was married to Miss Paz Torato of Tigbauan, Iloilo, on May 10, 1926.

Williams and Wilkins, publishers, place *Preparation of Technical and Scientific Papers*, by Trelease and Yule, second in the list of their best seller's for 1925.